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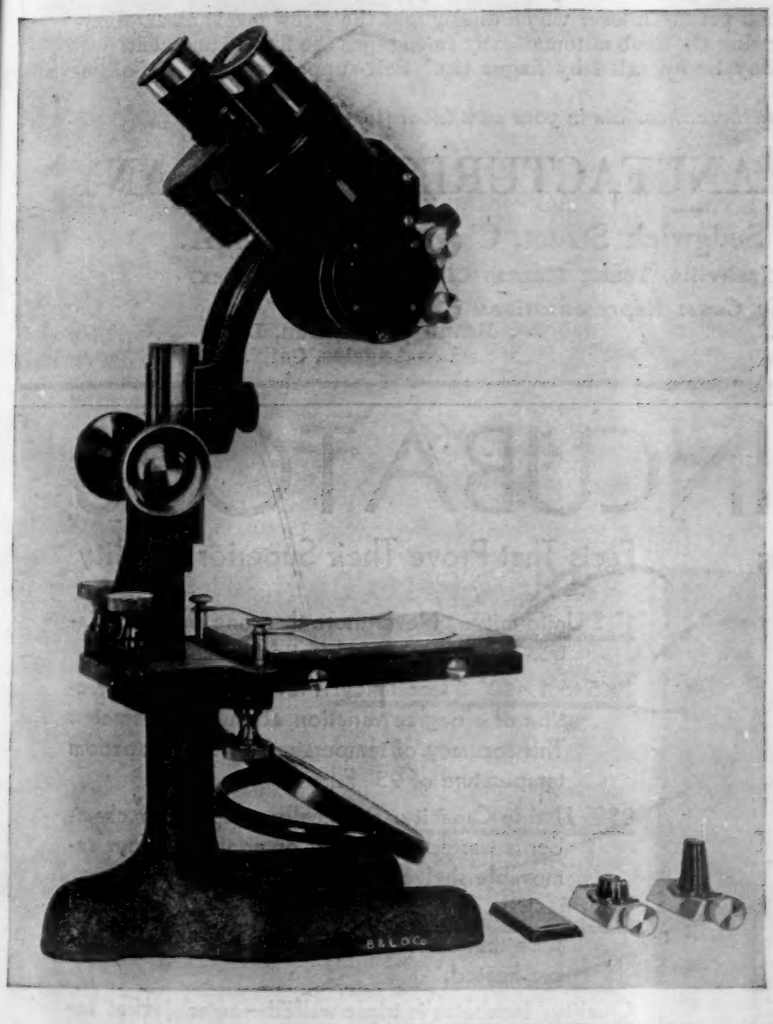

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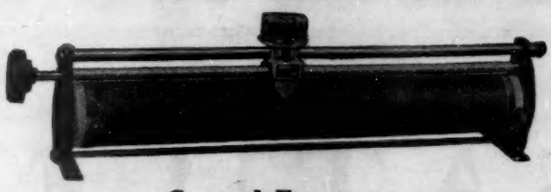

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THE PIONEERING PROCESS[1]

By Dr. ISAIAH BOWMAN

DIRECTOR OF THE AMERICAN GEOGRAPHICAL SOCIETY OF NEW YORK

So long as men "looked for a sign" the way of life was easy to find. Pioneer colonists took what the land offered: "That with their miseries they opened a way to their new-lands." This was man the wayfarer and burden-bearer, not man the destiny-guider. At length science began to interpret the physical world round about—its amplitude or scale, its great variety of environments, its favored areas, the breeding grounds and the courses of the storms, the way of the currents in the sea, the natural food supplies, and finally the improvements that could be made here and there by inventions and by technical processes that grew out of the attempt to apply scientific discoveries to man's own well-being.

Locke held that "it is easier to believe than to be scientifically instructed." Even now, in the full morning of the scientific day, crude belief is the basis of most of our human acts and relationships—a hunch that a given law, condition, social or economic arrangement is better than some or any other. The "method of science," which means the experimental method, is good enough for all but the affairs of men. In a sense this has been fortunate, for civilization could scarcely have had a beginning if the law of demonstration had always held sway. What was first needed was a rough-hewn scheme and a faith-yielding people. As life got more complex it became more troublesome to think about and the effects of a given act harder to anticipate and to measure. Always men have sighed for the good old times, meaning the simpler times. Even among "scientific" men, the *curiosi*, the individual is as apt as the rest of man-

[1] Address delivered at the annual banquet of the Society of the Sigma Xi, Yale University, March 19, 1932.

kind to be credulous and faith-giving outside his own bailiwick. Johnson's Dictionary of 1799 defined the word "scientifick" as "producing certainty." How we wish it did! After observing the part of science in the social forces of our day we are tempted to define it as "producing uncertainty." Strange mixed harvests of thinking and guesswork and faith go into the making of civilization!

In creating the elements of civilization it was discovered that the greatest single fact about humanity—despite all its fears and hesitations—is its willingness to advance across the border of experience: "and yet men strive to find a way." Every generation supplies its quota of men who question and venture and who are not dismayed by the failures and fears of others. The world is on a hinge and they want to swing it. Venturing mankind had to learn, however, that social evolution progressed only so fast as man could discover and control extra-human energies and apply them socially without smashing society in the process. Great as was the effect upon trade of the ocean-going ship, its greatest effect was in making possible new or greatly changed social and political systems through economic betterment that depended upon swifter and cheaper trade by sea. A full-rigged ship under sail develops at least 500 horse power, or 6,000 man power. These figures were of tremendous importance when they first became applicable, because the development of such unheard-of power required but a handful of men: two men can steer a full-rigged ship and twelve men furl her largest mainsail. Kingdoms and empires and economic and social systems came to be built upon this new form of extra-human energy, the ship.

The magic of science, its ameliorating influences upon life, the thousand and one conveniences which it has supplied—these are to-day but the elementary aspects of the situation. Science now presents a more serious aspect and is bound to more fateful consequences. In our time we have seen it as a sort of Trojan horse out of which have come arms and armaments and poison gas, and new opportunities to enslave and prey upon and destroy society. It was contended by Bagehot that it is the "highest genius of government to evoke new power." The power that he had in mind was the power to shape the economic and political systems of the day, the power really to guide the destiny of a nation. How tragic that the evocation of that power has lagged so far behind material things and powers that have profoundly changed human relations.

It is from such a standpoint that we may perhaps most advantageously look at those thrusts of culture into the undeveloped lands by a process we call pioneering. These thrusts have been largely haphazard in the past because our knowledge of the new environment of the frontier was both unsystematic and incomplete. The land-tilling pioneer had to be his own scientist. It was the "look" of the soil and the native vegetation upon which he largely depended. The pioneer has been continually gambling on the earth, at times confident that she would return a harvest, yet again and again disappointed in her, cursing her and then returning to gamble again. That is why the pioneer has been called a "luck-hunter." The trick was to learn "when to labor and when to wait without losing courage."

The forward thrust of population into new land means not merely a movement of people. It means also the extension of a system of agriculture as well as systems of economics and of social organization. The earth can not be viewed abstractly by the colonizer. A piece of land is not merely something to be judged according to its capacity of producing a given crop. The system of tillage that may be employed comes to have as much to do with the result as the rainfall. Great distance from market may prevent the exploitation of even the richest soil. The remoteness of a given region may make it impossible to maintain contact with neighbors and to participate in community life. These we call matters of "social density" and "economic density," and there are limits of toleration to both. At least this is true for the greater number of people, though account must also be taken of the pioneer of the Voortrekker type whose "neighbors' smoke shall vex his eyes" and whose chief purpose between birth and death seems to be to increase the distance between himself and a railroad.

Civilization is like a city—it is always being rebuilt. Always "in the center shall come another word," as one Maya glyph is rendered. This means that the outward thrust of civilization constantly changes its objectives, its degree of employment of the instruments of power and even its spirit. The history of pioneering is a history of mankind advancing into new territory by adapting instruments and attitudes and systems. If the pioneer of to-day expects success he must be responsive to world economic demands, and this requires him to have a definite production technique applied in a specific geographical environment whose possibilities have to be discovered one by one through experimentation. This has always been true to some extent. It is almost universally true of the remaining pioneer lands of the world because those lands are not always of the best. Most of them are marginal lands where the climatic extremes have an exceptionally wide swing, where the soils are notably different from those in regions that have "normal" climatic conditions. They lie on the colder, the hotter, the drier, or the more

distant borders of the areas of denser settlement. On the one hand they are bordered by belts of denser farming population, on the other hand by grasslands requiring an economy of their own and occupied by a scattered population.

It would be relatively simple for man to occupy the marginal lands in which modern pioneering goes forward if the advance were made by twos and threes and no thought given to the standard of living. As a matter of fact, the advance is made by communities, by groups of people, by colonies, or, as in Manchuria, by a swarm of humanity. Among all these there are two types, broadly speaking: first, those who go from machine-equipped communities with high standards of living; and, second, those who go from a land of hoe culture and tiny farms where there is small command over instruments of power. To the latter class pioneering is not in a high degree experimental, because the only question that is asked is whether human labor applied to the soil through a hoe or a plow will raise a crop that will sustain life and provide a small margin for purchases at a local trading center. To the former type—the machine-equipped pioneer—the question of a mere living is but one of a number of questions that confront him. He has in mind a standard of living. He does not merely live; he will try to live in a certain way. He looks not merely at the land under his feet and at the sky above; he looks back also to the communities which he left behind and he sees that government does things for communities. It provides them with railways and telegraph lines, with quick mail service, with schools and with marketing facilities. If not directly, at least it makes possible their doing or permits them to be done or encourages them to be done.

Nor do these things always depend upon the initiative or the demand of the pioneer. Government itself takes a hand in the pioneering process, to encourage it, to persuade more people to live upon the land, to provide a broader basis for the industries of its cities by extending the acreages of farms and the number of farmers, by making life upon the frontier *attractive* to the immigrant. Thus, Argentina and Brazil have at times attracted European migrants by the offer of free seed, free agricultural implements, and land at a low price with easy terms of payment. Organizations exist to help the settler. In London there are the Oversea Settlement Department, the 1820 Settlers' Association and others. In places in southern Africa the settler is received for a year upon an established farm as an apprentice to learn how to till the ground; in fact, to learn the whole business and technique of farming under local conditions. Government has taken a hand in group settlement in Western Australia, assisted migrants with free steamship fares, assured them a weekly wage, and offered them newly cleared land equipped with farm buildings at a reasonable price. Canada has maintained an alert attitude toward the streams of settlers that have flowed through her eastern ports and has sought to put them upon the land under conditions that would guarantee permanent occupation of new territory and types of community life that would make the new settler a part of Canada in a reasonably short time, a process known as Canadianization.

Technical studies have sometimes gone ahead of the pioneer, but more generally these have been of the reconnaissance type. The occupation of the new land has been experimental by the farmer himself. Here willingness plays a large part—willingness to experiment. In general, the city dweller wants his system set up for him. The farmer who has come from a given community to the border is more willing to try out a new scheme, accept for the time being a lower standard of living, and show some confidence in the future growth of the region. There is a great deal of pushing forward on all frontiers by the slow method of occupying land that is "just over there," with but little change in the culture system. The tillage is the same, the machinery required is the same, the crops are the same as those already known. Or, if changes are required, they are moderate. The old friends are near by and accessible. Such a movement asks no questions of the statistician or the scientist. It relies upon its own judgment. The men involved in it would scarcely look at a soil map. And it certainly scans no far horizon for opportunities that are or may be better than those near at hand. This type of advance is taking place wherever pioneer lands are available and in spite of a world-wide depression in agriculture, difficulties of transport, and apparently uneconomic distances to market.

Since the world war both science and government have concerned themselves very much more than before with questions arising out of the flow of population from country to country. The first general conclusion in the countries of the new world was that the flow from Europe should be greatly diminished. The streams of population were thus backed up at their sources, with a certain amount of international ill-will as a consequence. The damming process permitted the governments of the newer countries of the West to examine their economic and social structures and to determine how far population need be admitted at all or, when admitted, what disposition of it could safely be made. It seemed almost axiomatic that population could be admitted at almost any given rate so long as it was placed upon the land, for increasing acreages of tilled land were taken to mean increasing national strength. No one looked forward

to a day of pronounced agricultural overproduction the world around. No one had anticipated so great a disproportion between food production and food consumption.

The occupation of new land thus became the business of government, and the policies in relation thereto came to be intimately connected with national immigration policies. More and more we call our earth and its peoples "a world without frontiers," but this has reference to the flow of culture chiefly. As a matter of fact, we are more conscious than ever of political frontiers, and as for the pioneering border, that is now a matter of public and international concern. The "border" is not merely a fringe where people can be left to take care of themselves. We must incessantly strive if possible to foresee the consequences that will or may follow upon the adoption of any given policy. It is stupid to see only the facts that lie obviously before us. Science tries to be not merely responsive to events which have already happened but "creative of events which are about to happen."

The population problem becomes even more complex when we recall the extent to which land has been abandoned throughout our own country, communities left to rust out, and land to revert to perplexed state governments. We have discovered that it is unintelligent to grow everything that can be grown in a given place. More and more, agriculture is differentiating the earth. A thing tends to be grown in the place where it can be grown best, that is, most economically. There is surely no need of new farms unless they can produce more cheaply than the farms that are now in use.

Definitions have but a minor part in the process, in spite of the need for the application of principles embodied in definitions. The very basis of the state, said Confucius, was in "getting the words right"; but there is a higher law—making the words live. The American traveling in Europe has need for this sustaining truth as he takes his morning coffee, for the custom in that land of unhappy breakfasts is to boil and boil and boil, and so long as the grounds discolor the water the discolored water is coffee—by definition! It is not mere definition or technique but the living edge of experience that is required upon the border of land occupation. New communities have a noteworthy flexibility of spirit, a power of adaptation of social forms to the requirements of new situations. Whatever the physical likenesses of pioneer regions, each has its unique social and economic qualities, its distinctive peoples, its own rate of flow of life in new channels.

To one accustomed to think that pioneering is ended in the United States these may appear to be remote questions applicable to Siberia and Australia and the Canadian Northwest, but having little significance in our own land. This position would seem to be fortified by the declaration of our Bureau of the Census in 1890 that "the unsettled area has been so broken into by isolated bodies of settlement that there can hardly be said to be a frontier line." In consequence, the extent of the unsettled area and the line that marked the border of advancing settlement were no longer emphasized in the census reports, which led later commentators to think that frontier conditions had passed and that the years immediately preceding 1890 marked the end of pioneering.

There are two important corrections to be applied to this simple concept. In the first place, the line between settled and unsettled country was drawn between population densities of two to the square mile and less than two, when as a matter of fact there are large areas of permanently settled western country that have less than two to the square mile, if (like the census of 1890) we take counties and smaller civil divisions as units and average the population. The second correction is still more important. The removal of a line from the map merely because that line has ceased to advance into unsettled country does not mark the end of pioneering. For pioneering is a process of experimentation, not merely an advance, and so long as the experimentation continues so long do pioneering conditions persist. I was first made aware of the existence and significance of long-continued frontier conditions while engaged in field studies in South America in 1907, in the course of the first Yale South American expedition. Again in 1913 I visited some of the oldest towns in South America on both the eastern and the western borders of the Andes in Argentina and Chile. Among them are Salta and Copiadó and the then isolated town of San Pedro de Atacama in Chile. In the frontier communities tributary to these towns one could still find many characteristics of frontier living. Here was what might be called a crystallized frontier type of life.

The same process of crystallization has taken place in our "zones of experimentation" in the Far West. On every hand one is made aware that he is on the border of the tilled land, not within the core. In core areas the rainfall may vary considerably and crops may vary accordingly. But at least there is some crop. By contrast the border of the tilled land is everywhere characterized by climatic extremes. These extremes do not mean merely a change in the output of grain and other products: they may mean a complete failure to produce anything at all from the ground. The problem of occupation of such areas is therefore expressed not merely by saying that there

will be some years in which there is little or no crop and other years in which there will be abundant crops—perhaps sufficiently abundant to enable the farmer to accumulate reserves that will tide him over the dry years.[2] No, the problem is much more complicated than that because the moment there is a technological improvement in the methods or the machinery of farming there may be a very great change for the better or for the worse in the economic condition of the farmers in a given zone of experiment. That is a first possibility. A second possibility is that world production will change very greatly—now it will be high and again it may be very low. According as it varies it will affect the market price. This means, further, that farming in the zone of experimentation may be affected by world market prices as profoundly as by either years of abundant rainfall or years of drought. Lastly, there is a variation in rainfall that may be combined one way or another with the two variations noted above.

All this means that we have a permanent zone of experimentation along the border of the tilled land and that population is still advancing and retreating in local areas and still experimenting with the specific qualities of their land and their community and market possibilities. They are looking for new tools and new knowledge that will enable them to possess the land more securely. They are still inquiring how far it is profitable to advance into new climatic regions or how far they have already exceeded the limits of permanently successful occupation. Our successive land laws have recognized the need for units of land of varying size, subregion by subregion, but the application of the law has been very rough and needs to be refined on the basis of land classification studies still in progress. Insurance against extremes of climate may be desirable in the future, but what insurance can there be against something equally important, the wide fluctuation of the market price?

These are but indications of the categories of inquiry and fact in which the geographer is interested in his intensive study of the zone of experimentation called "the pioneer fringe." Economic, historical and sociological problems are also involved. Where earlier students saw the line of pioneering halted and a condition made static, the geographer sees a continuing dynamic. The frontier type of living is in a sense a permanent feature of the life of our western border country. Here the population must constantly experiment, constantly gamble on climate and market price if the land is to be occupied. The man who is unwilling to guess that the rainfall will be sufficient for a crop will never sow his seed and take his chances with rainfall or, rather, with drought. The process of adjustment is endless.

We can not say merely, "Withdraw farmers from the marginal lands and let grazing become the permanent form of occupation." There is no such thing as a "permanent" type of land use on our climatic borders. Moreover, the whole of society and economics is changing constantly. So, too, will the use of the land, and, so long as periods of wet years come on the dry borders and periods of frostless and protracted growing seasons on the cold borders, so long will settlers try their luck again and again, hazard their living on their guess that a crop can be raised, and challenge science to forecast the extremes of climate with which they gamble.

In a wider survey of pioneer lands in other continents we become aware of further complexities in the pioneering process that grow out of differences of race and system. Twenty million Chinese have gathered in Manchuria, first pushed out of the crowded regions farther south, especially Shantung, and later attracted to the fertile acres of the pioneer fringe farther north by the higher standard of living that they were able to win and by the establishment of communities that restored to them to a measurable degree the life they had left behind. Some change in dietary habits had also to be made and new methods learned of raising crops under unaccustomed climatic conditions. At last upon land that was long a "far north" to the Chinese there was developed a vast new political province served by a network of rails, "the civilizing rails," to use Jefferson's phrase. A broad, thinly peopled belt of frontier territory was changed to a field of political strife. A distant border has become a focus of intense international rivalry.

Southern Africa presents a wholly different group of problems. Here the pioneers have come among large native populations as masters who believe themselves capable of exercising power over both white and black and holding the scales of justice evenly at the same time. After the occupation of the southern coastal girdle of more accessible and better-favored land, white occupation spread northward following in recent years interior uplands upon whose summits and about whose borders the white man found it tolerable to live and work despite increasing nearness to the equator. The land was endowed in a number of places with mineral deposits of exceptional richness and value, with the consequence that railways could be supported virtually by mines alone. Railways thus became agents of pioneering, forerunners of

[2] A two-year supply of forage for farm animals is commonly kept "in sight" in the western part of the High Plains of eastern New Mexico ("The Pioneer Fringe," published by the American Geographical Society of New York, 1931, p. 118. In this book and in a companion publication entitled "Pioneer Settlement" are a large number of maps showing the world's remaining pioneer lands).

land settlement. Plantations came into being on both sides of every railway line. Lacking the mine-railway combination land settlement would have been slowed down or halted altogether because the soils of southern Africa are naturally infertile, "desperately poor" in organic matter. Phosphorus is generally lacking. There is also a deficiency and high variability of rainfall over most of the territory. Climatic instability tends to retard settlement and the growth of white population. When there is a swing of rainfall from a wet to a dry phase the effects are not local but widespread, and on the borders of settlement they have again and again been devastating.

Even now the principal crops of the Union are extremely low in average yield, maize being about one third of a crop, judged by American standards. More intensive and diversified cultivation in the favored areas and a greater differentiation of land use has been the result. The country has tended to break up into better demarcated regions with ranching and transitional farming coming in upon the poorer lands. In the high veld of the southern and southeastern Transvaal, for example, the vast farms of an earlier day are no longer the rule. Two hundred to four hundred acre tracts are now common. In the northwestern part of the high veld the rainfall is less reliable and land values are low. Individual holdings are therefore larger—up to two thousand acres. In the Limpopo Valley, still farther north, acreages run as high as ten thousand per individual holding. Always in the direction of uncertainty of rainfall the size of the farms tends to be larger and occupation more unstable. This instability makes its special appeal to legislators, who number among them a large proportion of farmers; and the consequence is possibly "an over-expenditure of state funds to relieve the hardships of the sufferers."

A culture system based upon the plantation has given pioneering in South America a distinctive stamp. In some places the native population was exploited under the institution known as peonage, a mild form of slavery. Ownership of property and land was reserved for the whites, who were from the beginning a privileged class. One effect of the plantation system and an available supply of native labor was that it brought lands under cultivation which would otherwise have been too distant to exploit economically, and it thus provided government with larger and larger acreages of taxable property. Mineral and rubber concessions were found to be profitable devices to secure roads and bridges to outlying districts. Thus the chain of Andean states running from Argentina to Panama contrived to bind their scattered agricultural lands into something like units and to hold isolated population groups together in loosely organized political systems.

The second half of the nineteenth century, the period in which most of the railroads were built, witnessed, curiously enough, a drawing-in of the limits of settlement in many remarkable instances, as men became tied to the new economic system of which the railroad was the symbol and in which time came to be more and more important. The speed of transportation now became an inescapable part of the process of moving goods and men. The United States has no class upon whose shoulders can be dropped so heavy a load as that which is dropped by the South American upon the lowest ranks of his society. He is intent upon maintaining the privileges and luxuries of a class: all is well if these privileges and luxuries are being enjoyed; all is wrong if they are taken away, no matter what the reason may be. In unbroken sequence the concepts that so long ruled Iberian life may be traced through the colonial period and the period of liberation in South America down to our own time.

The plantation system in South America persists in some places because it is economically best for all concerned, while in other places it is a device employed by the landowners for maintaining an essentially aristocratic system based upon land. In cereal-growing Argentina, large landholdings became the rule when Argentina was primarily a pastoral country; they have persisted through the change into a cereal-growing system in which pastoral interests still bulk large. The large landowner really doesn't want to give the small landowner a chance. He wants to maintain his system as he found it. "Agriculture has here become the handmaid of stock raising." Fully one half the grain exported from the republic is an incident to cattle raising. Seeing that his once cheap (and in places worthless) land has increased in value and made a fortune for him, the owner has made up his mind not to part with any more of it. Says Jefferson, "He could get a lot of money for his land if he sold it, but what should he do with the money? . . . He might lose it; and wasn't the value of the land increasing every day? Better keep the land and let the gringo [foreigner, *i.e.* European immigrant] go on working for him."[3]

Coupled with this state of things is the feeling that only members of the upper class are intelligent and responsible. In their view they own the land and govern the community in quite a proper sense. The peon has a station in life akin to that of the peasant in Europe, and the educated Argentine knows the

[3] Mark Jefferson: Peopling the Argentine Pampas, *Amer. Geogr. Soc. Research Series, No. 16,* New York, 1926, pp. 168–169.

culture and economic systems of Europe better by far than he knows the development of the really democratic systems of the New World that he thinks himself a part of. Little wonder, under such a system, that not all the good tillable land is by any means yet occupied. To the untilled acres must be added the economic loss sustained by a superficial cropping of the land.

In the Frontera of Chile we are witnessing to-day the last successful large-scale occupation of new land in that country. The patronage of the government has been extended to new settlers, who in past years have included both Chileans and Germans. Government even went so far as to forgive "obligations that turned out to be unreasonable." This humane attitude may be called "enlightened selfishness," for in the provinces farther north the point of saturation of population density has been approached, and government is obliged to turn to the pioneer zone of southern Chile and to the development of industries based on mineral deposits, enact social legislation of an advanced type, and develop something like a balanced agrarian program.

Where the line of settlement ends in Chile will depend upon the value of the products that the settler can get from the soil and upon the limits of human tolerability with respect to rain and its consequences in muddy roads and shortened seasons of labor. The experience of hardy settlers on many frontiers shows that the limits of tolerability can not be forecast. The Frontera is therefore a region of experimentation in a broad sense. Trees have to be felled, rain endured, and poor communications as well, and specialized production practiced. The environment is new and strange to the colonizing Chilean; and it can hardly appear as the best of earth to the German or French or Swiss immigrant. Government will improve some of the conditions, no doubt, as it has done in the past.

Cast in different form are the settlement problems of the eastern Andean valleys all the way from Venezuela and Colombia, on the north, southward along or near the Andean border, down through Bolivia and Argentina to the Strait of Magellan. On the north are tropical valleys far removed from the highland centers of population in the sense that steep and long grades must be overcome to get products out; and separated on the east by broad stretches of lowland, densely forested, that run to the Atlantic. In the Gran Chaco of Bolivia and Paraguay settlement has pressed forward far enough to bring this once useless land within the international framework. For centuries it was empty land beyond the outposts of settlement; to-day it is the scene of armed conflict between Paraguay and Bolivia and is involved in one of the major international boundary disputes of South America—all because of the value of the Paraguay River as a commercial outlet and the undeveloped resources of timber and pasture that have attracted the attention of political and commercial leaders. Northern Patagonia has for several decades been the scene of increasing colonization by farmers and herdsmen; and in scattered situations in central and southern Patagonia grazing interests have everywhere sought out the better sites.

Without attempting to describe the remaining pioneer lands, we may take a look, in closing, at a professional aspect of the problem of pioneering that may not be without interest to you. It will be clear from a review of the concepts that we have dealt with that "a science of settlement" can not be developed by a single discipline. The moment institutions are taken into account, the moment we challenge a given system, the moment we deal with the actual complexities of the problems of present-day life, we are bound to consult widely. Of necessity the individual is really expert only in a narrow field. It is time that restricts him, not narrowness of spirit or limited outlook. Time is required for that indispensable mastery of at least one technique, or several techniques, that is necessary if one is to make progress in original investigation. But the moment one leaves an area of special expertness and enters a broad field of inquiry like pioneer settlement one must bring experts together. For when the individual attempts to cross over into an unfamiliar field he is apt to drop back to the elementary generalities or concepts of the textbooks. Here it is that cooperation with his fellows enables him to avoid the worst consequences of his deficiency. By this means there is mutual education at a rapid pace of experts who have ideas and techniques, variant and unfamiliar (as between different groups), that it is sought to apply to a problem of common interest.

Cooperative research is not a mere trading of ideas, not just a speeding-up of output; nor is it a new form of magic. It definitely is a means of rendering neutral and harmless the tendency to certainty, the too great simplification of ideas, and enslavement to accepted methods. Through the medium of a common problem it locates the living edge of experience and opinion in related fields. The first results of modern science were considered so beautifully demonstrative that, backed by forensic power, they were made to seem final and complete. The tendency may be offset by getting away from the rules and seeing realities naïvely as well as through the "principles" that embody the generalizations of a single science.

A practical test of the method is now being made

by a group of Canadian scholars who have formed a "Canadian Pioneer Problems Committee," working under the auspices of the American Geographical Society and supported on the one hand by the Social Science Research Council and on the other by individuals, institutions, and bureaus of government in Canada. Two field seasons have been occupied in gathering information first hand according to a well-defined but flexible scheme of investigation set up the beginning. The successive annual reports of t committee have demonstrated the wisdom of t method, and within a year or two there will appear number of volumes of results that can not fail to of importance to Canada as a nation as well as other countries having large areas of marginal lan which are or will soon be in process of developme

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON

ACCORDING to the annual report of the Zoological Society of London, as reported in the London *Times*, the assets of the society amount to £177,708, a decrease of £493 on the corresponding figures for last year, but these do not include the capital of the De Arroyave Trust Fund, the chief item in which is a holding in consolidated 2½ per cent. stock of £123,889. The total income of the year was £141,525, an increase of over £7,000 on that of last year. The income from the Regent's Park Gardens was much less than in 1930, chiefly on account of the bad weather during the greater part of the season, but this was more than made up by the income from the new park at Whipsnade, opened for the first time last Whitsuntide. The total number of fellows decreased from 8,430 to 8,307, as the new fellows elected did not balance the number of deaths and resignations.

The gardens are again to be kept open until 11 P. M. on Thursday evenings from June 2 to August 25 inclusive, and the J. H. Squire Celeste Octet is to play during dinner. On Saturdays and Sundays from May 28 to August 28, inclusive, the band of the 65th (8th London) Field Brigade, Royal Artillery, will play in the afternoons. It is regarded as doubtful if the Thursday evening late openings actually cover the cost of the extra attendance and lighting, but they give an opportunity to many persons engaged during the day to see the collection.

Notwithstanding the bad weather, there were only 27 deaths among the animals from tuberculosis, the lowest since 1925, and of these only one was a monkey which had been 11 months in the gardens and had probably been affected before its arrival. Among the mammals bred and reared in the gardens were three kangaroos and wallabies, two opossums, three porcupines, three musquash, four agoutis, four coypus, a yak, bison, Mongolian wild horses, Grévy's zebra, sea-lion, lion, eland, black-buck, water-buck, nylghaie and lemur, four ibex, 10 wolves, four Barbary wild sheep, and six thar. Among the birds bred and reared the most notable successes were four Cape penguins, one macaw, one cockatiel, 20 parrakeets belonging to several species, and 138 budgerigars, including green, yellow and blue varieties. At Whipsnade one wombat one llama, one yak, one red deer, one fallow deer, tw nylghaie, two black-buck, two white red deer, tw Chartley and five Highland cattle, and six wolves wer bred and reared.

RESEARCH COMMITTEES OF THE SECTION OF HYDROLOGY OF THE AMERICAN GEOPHYSICAL UNION

THE Section of Hydrology of the American Geophysical Union has announced the organization of nine permanent research committees. This section is concerned with the study of the waters of the earth from the time they are precipitated upon the surface as rain or sn until they are returned to the atmosphere or are discharged into the ocean. Each committee is to make an annual survey of work in progress in the field of hydrology which it covers and to maintain contact with the workers in its field. Following is a list of the committees and chairmen, together with brief statements of the field to be covered by each committee:

Committee on Snow: J. E. Church, meteorologist, Nevada Agricultural Experiment Station, and adviser, Nevada Cooperative Snow Surveys, University of Nevada, Reno. The quantity and distribution of the snowfall, the methods of making snow surveys, the melting and evaporation of the snow and the relation of the snow to run-off and absorption.

Committee on Glaciers: F. E. Matthes, geologist, Geologic Branch, U. S. Geological Survey, Washington, D. C. The hydrology of existing glaciers, as distinguished from the work and products of ancient glaciers. The committee is to obtain and interpret systematic records of the advance and retreat of glaciers in the United States, including Alaska; also, related records of the movement of the ice, weather conditions and the discharge of water from the glaciers.

Committee on Evaporation: G. F. McEwen, oceanographer, Scripps Institution of Oceanography, University of California, La Jolla. The rate of evaporation from free-water surfaces, the effects of weather and other conditions that influence evaporation, and the methods of determining evaporation; also, the fluctuations of lakes and their causes.

Committee on Absorption and Transpiration: C. H.

Lee, consulting hydraulic engineer, San Francisco. The absorption of rain, snow and stream water into the earth and its penetration to the water table; the discharge of water by evaporation from the soil and by the transpiration of plants, and the effects of intake and discharge on the ground-water levels.

Committee on Run-off: L. K. Sherman, consulting engineer, Randolph-Perkins Co., Chicago. The quantities of water discharged by the streams and the fluctuations in the rates of discharge; also, the geographic, climatic and other conditions that influence the rate of discharge.

Committee on Physics of Soil Moisture: F. J. Veihmeyer, professor of irrigation investigations and practice, College of Agriculture, University of California, Davis. The molecular forces that control or influence the occurrence and movement of water in the interstices of the soil and rock formations, including the dynamics of soil moisture in land slides, mud-flows, subsidences and frost action.

Committee on Underground Water: D. G. Thompson, geologist, Water Resources Branch, U. S. Geological Survey, Washington, D. C. The occurrence, head and movement of the water in the zone of saturation.

Committee on Dynamics of Streams: L. G. Straub, professor of hydraulic engineering, University of Minnesota, Minneapolis. The laws of flow of water in rivers and smaller streams, the forces w[illegible]he water exerts, the work which it does in erosion, transportation and deposition, and the relations betw[illegible]the streams and the channels that they occupy.

Committee on Chemistry of Natural Waters: C. S. Scofield, agriculturist in charge, Division of Western Irrigation Agriculture, U. S. Bureau of Plant Industry, Washington, D. C. The chemical composition and chemical work of the natural waters, both above and below the surface; also, the relation of the fresh water to the salt water, both above and below the surface.

THE NATIONAL PARKS ASSOCIATION

PLANS for rounding out and developing the nation's system of national parks were discussed at the annual meeting of the National Parks Association held at the Cosmos Club, Washington, D. C., on May 9. Presided over by Dr. Wallace W. Atwood, president of Clark University, this meeting was attended by many of the leaders in conservation who constitute the board of trustees of the association.

Dr. Ray Lyman Wilbur, Secretary of the Interior; Frederic C. Walcott, United States Senator from Connecticut; Dr. John C. Merriam, president of the Carnegie Institution of Washington; Horace M. Albright, director of the National Park Service, and Dr. Atwood were the principal speakers at the annual dinner which followed the afternoon business session, and was attended by more than 150 persons interested in the welfare of the national parks.

Describing the national parks and monuments as the most unique educational agencies in our national life, Dr. Wilbur praised the work of the association in furthering interest and support for the work of the National Park Service in developing and protecting these important educational and recreational areas and asked for its continued interest. Beauty in the national parks, both natural and man-made, was emphasized by Mr. Albright, director of the National Park Service, in an illustrated talk which included colored slides of beautiful scenes in the park system. Special interest was manifested in the pictures of Great Smoky Mountains National Park, the newest in the system, and the proposed Shenandoah Park in the Virginia Blue Ridge, the Everglades, which, if established, will be the only tropical park in the system, and Isle Royale, a beautiful Michigan island in Lake Superior. All these projects have been authorized by the Congress.

Preservation of wild life in our national parks was the subject of Senator Walcott's address. Dr. Merriam stressed the relation of the citizen to the national parks.

Since the establishment of the National Park Service as a bureau of the Department of the Interior in 1916, more than 25,000,000 persons have visited these parks and monuments. With one exception during the war the total number of visitors for each succeeding year has established a new record.

THE AMERICAN PHYSICAL SOCIETY

THE American Physical Society will hold its one hundred and seventy-ninth meeting at New Haven, Connecticut, on June 23, 24 and 25.

On Friday morning, June 24, there will be a program of invited papers on "X-rays and What They Suggest about Atomic and Other Structures." The speakers will be J. A. Bearden, J. W. M. DuMond, J. A. Gray and J. D. Hanawalt.

On Saturday morning there will be a program on "Plasticity" arranged by the division of applied mechanics of the American Society of Mechanical Engineers. Physicists have been invited to present papers on this subject from the point of view of physics and the Physical Society has been asked to join with the engineers in this session. The invited papers will be by F. Zwicky, Francis Bitter and R. L. Wegel.

Most of the contributed ten-minute papers will be read on Thursday morning. If necessary, a few may be carried over into Friday and Saturday mornings at times not conflicting with the hours of the symposia, or they may be presented before special conference groups. Conferences or round-table discussions on topics selected by request will be a feature of this meeting.

On Thursday afternoon, before a tea to be given out of doors or in the library, there will be an inspection of the Sterling Memorial Library, including spe-

cial exhibits of books, maps, etc. The annual dinner of the society, held in conjunction with the American Society of Mechanical Engineers, will be followed by a complimentary performance of Milne's "The Perfect Alibi" by Yale students; there will also be a joint excursion starting late on Friday afternoon, including sea bathing, sports, a picnic supper and dancing. A limited number of reservations can be made on an observation train leaving New London at 5:40, standard time, on Friday to view the Yale-Harvard Boat Race.

THE SIXTH INTERNATIONAL CONGRESS OF GENETICS

THE following visitors to the Sixth International Congress of Genetics (Ithaca, New York, August 24–31, 1932) will be in the United States before or after the congress in order to deliver lectures at American universities and colleges.

Professor Kristine Bonnevie, University of Oslo.

Dr. R. A. Fisher, Rothamsted Experimental Station, Harpenden, England.

Professor R. Ruggles Gates, University of London.

Professor Richard Goldschmidt, Kaiser Wilhelm Institut für Biologie, Berlin-Dahlem.

Dr. J. B. S. Haldane, John Innes Horticultural Institution, Merton-London.

Dr. John Hammond, University of Cambridge, Cambridge.

Professor Julian Huxley, King's College, University of London.

Dr. H. Kihara, Kyoto Imperial University, Kyoto.

Dr. G. A. Levitsky, Institute of Applied Botany, Leningrad.

Professor Otto Mohr, University of Oslo.

Professor Hans Nachtsheim, Institut für Vererbungsforschung, Berlin-Dahlem.

Dr. M. Nawaschin, Moscow, U. S. S. R.

Dr. Curt Stern, Kaiser Wilhelm Institut für Biologie, Berlin-Dahlem.

Dr. N. Timofeeff-Ressovsky, Kaiser Wilhelm Institut für Hirnforschung, Berlin-Buch.

Professor N. Vaviloff, Institute of Applied Botany, Leningrad, U. S. S. R.

Dr. Paul Weiss, Vienna (now at Yale University).

Professor O. Winge, Royal Veterinary College, Copenhagen.

Professor M. J. Sirks, Agricultural College, Wageningen, Holland.

Dr. Alexander Serebrovsky, Timiriazev Institute, Moscow.

Other visitors who will probably come and who may be available for lectures are:

Dr. G. P. Frets, Municipal Hospital, Portugal, Rotterdam.

Dr. E. J. Gumbel, Heidelberg University, Heidelberg.

Dr. Ivar Johansson, Agricultural College, Uppsala.

Dr. G. D. Karpechenko, Institute of Botany, Detskoe-Seloe, Leningrad.

Dr. Klass Tjebbes, Sugar Beet Research Station, Landskrona, Sweden.

Many other geneticists will doubtless come from abroad, but definite statements can not be made yet. Information concerning dates and lecture subjects of visitors to the congress may be obtained from the Transportation Committee, care of L. C. Dunn, Columbia University.

APPROPRIATIONS FOR GRANTS-IN-AID BY THE NATIONAL RESEARCH COUNCIL

AT its April meeting the National Research Council's Committee on Grants-in-Aid made thirty-one grants for the support of individual research as follows, from eighty-one applications received:

Frank C. Jordan, director, Allegheny Observatory, Pittsburgh, Pennsylvania, the measurement and reduction of parallax plates; W. J. Luyten, head of the department of astronomy, University of Minnesota, the proper motions of the stars.

William D. Harkins, professor of chemistry, University of Chicago, a photographic study of the synthesis and disintegration of atoms; B. Smith Hopkins, professor of inorganic chemistry, University of Illinois, the properties of illinium; Karl Paul Link, professor of biochemistry, University of Wisconsin, the preparation of the naturally occurring hexuronic acids.

Ralph L. Belknap, assistant professor of geology, University of Michigan, the establishment and operation of a weather station on the west coast of Greenland; Margaret F. Boos, Bartlesville, Oklahoma, granites of the Silver Plume and Longs Peak Batholith, Colorado; Bruce L. Clark, associate professor of paleontology and historical geology, University of California, the Tertiary faunas and sections of the Southern part of the United States, and of selected localities in Europe; Charles E. Decker, professor of paleontology, University of Oklahoma, the large graptolite fauna of the Viola limestone; John M. Muir, Fort Worth, Texas, monograph on Mexican oilfields, and a general map of the surface geology of the Tampico embayment; A. Russell Oliver, fellow in geography, Clark University, land utilization in the Judith Basin, Montana.

Robert Chambers, professor of biology, New York University, the functions of the kidney; Paul F. Clark, professor of bacteriology, University of Wisconsin Medical School, the concentration of the virus of poliomyelitis; R. W. Gerard, associate professor of physiology, University of Chicago, the activity of nerve tissue and the central nervous system; Robert

Hegner, director, department of protozoology, School of Hygiene and Public Health, Johns Hopkins University, amebiasis in Panama; William C. Rose, professor of physiological chemistry, University of Illinois, the nutritive importance of the amino acids; Gordon H. Scott, associate professor of cytology, Washington University, the distribution of mineral salts in nerve cells and fibers.

Charles E. Burt, professor of biology, Southwestern College, the lizards of the United States and Canada; F. G. Gustafson, assistant professor of botany, University of Michigan, the anaerobic respiration of cacti; E. B. Hart, professor of agricultural chemistry, University of Wisconsin, the form and availability as food for animals of the iron in plant and animal tissues; LaDema M. Langdon, assistant professor of biology, Goucher College, the embryogeny of the Juglandaceae and Fagaceae; William J. Robbins, professor of botany, University of Missouri, determination of the conditions necessary for the continued cultivation of excised tissues; V. E. Shelford, professor of zoology, University of Illinois, the rodents of the Canadian tundra.

Leonard Carmichael, professor of psychology, Brown University, the cutaneous reflexogenous zones in the fetal guinea pig; Franklin Fearing, associate professor of psychology, Northwestern University, the functions of the non-acoustic labyrinth in birds; Laurence Foster, Stowe Teachers College, St. Louis, racial mixture between Negro, Indian and White stock in Maryland and Delaware; William Morgan, research associate, Yale University, personality studies of Navaho Indians; George M. Peterson, assistant professor of psychology, University of Denver, mechanisms of handedness in the rat; E. Sapir, department of social sciences, Yale University, songs of the Nitinat Indians; T. C. Schneirla, assistant professor of psychology, New York University, the behavior of the legionary ants of Panama of the sub-family Dorylinae; Calvin P. Stone, professor of psychology, Stanford University, mental characteristics of senile male albino rats.

GEORGE K. BURGESS,
Chairman

THE MEDAL MEETING OF THE FRANKLIN INSTITUTE

AT the annual medal meeting of the Franklin Institute on May 18 the following medals and awards were presented:

Certificate of Honorary Membership, George A. Hoadley, Sc.D., Swarthmore, Pennsylvania.

Certificate of Merit, Thomas Randolph Harrison, The Brown Instrument Company, Philadelphia.

The Longstreth Medal, Josua Gabriel Paulin, System Paulin Aktiebolag, Stockholm.

The Wetherill Medals, Halvor Olsen Hem, Toledo Scale Manufacturing Company, Ohio; Monroe Calculating Machine Company, Inc., Orange, New Jersey; Messrs. Baltzar Carl von Platen and Carl Georg Munters, Platen-Munters Refrigerating System, Stockholm; Frank Wenner, Bureau of Standards.

The Levy Medal, Wayne Buckles Nottingham, assistant professor of physics, Massachusetts Institute of Technology.

The Clark Medal, Philip Thornton Dashiell, United Gas Improvement Company, Philadelphia.

The Potts Medal, George Paget Thomson, professor of physics, Imperial College of Science and Technology, London.

The Cresson Medals, Percy Williams Bridgman, professor of physics, Harvard University; Charles LeGeyt Fortescue, Westinghouse Electric and Manufacturing Company, Pittsburgh; John Boswell Whitehead, dean, School of Engineering, the Johns Hopkins University.

The Franklin Medal and Certificate of Honorary Membership, Ambrose Swasey, The Warner and Swasey Company, Cleveland; Philipp Lenard, director, Radiological Institute, University of Heidelberg; received by the German Consul General in New York, Dr. O. C. Kiep.

Papers will be presented by the Franklin medalists: One entitled "Some Scientific Views" will be presented *in absentia* by Dr. Lenard and Dr. Swasey will speak on "Astronomers and Their Telescopes."

SCIENTIFIC NOTES AND NEWS

THE degree of honorary doctor of medicine has been conferred by the University of Amsterdam on Dr. Harvey Cushing, Moseley professor of surgery in the Harvard Medical School and surgeon-in-chief of the Peter Bent Brigham Hospital. Dr. Cushing plans to relinquish his work at the school and the hospital at the end of the academic year.

ON the occasion of the celebration of the commencement of the Michigan College of Mining and Technology at Houghton the honorary degree of doctor of engineering will be conferred on Scott Turner, director of the U. S. Bureau of Mines, and on C. Harry Benedict, chief chemist of the Calumet and Hecla Mining Company. Mr. Turner will be the commencement speaker.

DR. TREAT B. JOHNSON, Sterling professor of chemistry at Yale University, and Dr. Herbert M. Evans, director of the Institute of Experimental Biology at the University of California, were among those elected to membership in the German Imperial Academy of Sciences at Halle at the meeting held on March 17 in commemoration of the centenary of the death of Goethe.

PROFESSOR ALBERT EINSTEIN is in England where he planned to spend three weeks at Christ Church College, Oxford. He delivered the lecture on the Rouse Ball Foundation at the University of Cambridge on May 6. The title of the lecture was "Die Theorie der Elektrizität im Rahmen der allgemeinen Relativitätstheorie." The doctorate of laws will be conferred on Dr. Einstein by the University of Glasgow. On account of engagements, however, he is unable to be present in June, but plans to attend the graduation ceremonies in 1933.

ELECTIONS of corresponding members of the Bavarian Academy of Sciences include: Dr. Ludwig Jost, professor of plant physiology at Heidelberg; Dr. Franz Kossmat, professor of geology at Leipzig, and Dr. Hans Stelle, professor of geology and paleontology at Göttingen.

M. M. VILLAT, professor at the Sorbonne, Paris, has been elected a member of the Paris Academy of Sciences in the section of mechanics to succeed the late G. Koenigs.

DR. CHARLES H. HERTY, of New York, chemical industrial consultant, received the medal of the American Institute of Chemists for "noteworthy and outstanding service to the science and profession of chemistry in America" at the annual meeting of the institute in New York City on May 7. Dr. Frederick E. Breithut, president of the institute, presided and made the presentation. Other speakers were: Joseph E. Ransdell, former U. S. Senator from Louisiana and now executive director of the conference board of the National Institute of Health; Dr. Marston T. Bogert, professor of organic chemistry at Columbia University, and Henry W. Jessup, lawyer. Former recipients of the annual medal include Andrew W. and Richard B. Mellon, for the establishment of the Mellon Institute for Industrial Research; the late George Eastman, and Mr. and Mrs. Francis P. Garvan, who established the Chemical Foundation.

JUAN DE LA CIERVA has been awarded the Guggenheim Gold Medal of 1932 for development of the theory and practice of the autogyro. This award was made by a board having eight members in the United States of America and seven foreign members. The foreign countries represented are Canada, England, France, Germany, Holland, Italy and Japan. The Daniel Guggenheim Medal was established in 1928 by the Daniel Guggenheim Fund for the Promotion of Aeronautics. It is sponsored jointly by the American Society of Mechanical Engineers and the Society of Automotive Engineers, each of whom appoint four members of the board of award. The president of the 1931–32 board, which awarded the medal to Mr. Cierva was Admiral H. I. Cone, commissioner of the U. S. Shipping Board. At the recent annual meeting, Captain Emory S. Land, of the Navy, was elected president for 1932–33, and Major E. E. Aldrin, vice-president. Medals have been awarded previously to Orville Wright, Ludwig Prandtl, Germany, and Frederick William Lanchester, England.

WILLIAM E. MOTT, retiring director of the College of Engineering of the Carnegie Institute of Technology, Pittsburgh, was the guest of honor at a dinner recently given by Dr. Thomas S. Baker, president of the institute.

FOUR senior members of the faculty of the Boston University School of Medicine—Dr. J. Emmons Briggs, professor of surgery; Dr. Alonzo G. Howard, professor of orthopedic surgery; Dr. Wesley T. Lee, professor of dermatology, and Dr. Clarence H. Dobson, assistant in medicine—and the staff of the Massachusetts Memorial Hospitals were honored with special recognition of their services to the two institutions, by more than a hundred of their colleagues at a testimonial dinner recently given in the University Club.

THE seventeenth annual meeting of the South Dakota Academy of Science was held at Yankton College, South Dakota, on May 6 and 7. The reading of papers by members occupied Friday afternoon and Saturday morning. After the academy dinner on Friday evening, Dr. S. C. Lind, director of the School of Chemistry of the University of Minnesota, delivered an address on "The Contributions of Radioactivity to Science." The following officers were elected for the year 1932–33: *President,* George Gilbertson, State College; *First Vice-president,* A. V. Arlton, Dakota Wesleyan University; *Second Vice-president,* Edw. P. Churchill, University of South Dakota; *Secretary-treasurer,* A. L. Haines, University of South Dakota.

DEAN WILLIAM F. LASBY, of the College of Dentistry at the University of Minnesota, was elected president of the American Association of Dental Schools at the recent meeting in Columbus, Ohio. Dean Lasby will take office in 1933.

ON the evening of May 10 was held the ninth annual meeting of the Virginia Chapter of Sigma Xi. Fifteen candidates were admitted to membership at this meeting. The annual address was delivered by Dr. Carl C. Speidel, professor of anatomy in the University of Virginia Medical School, on "The Growth and Repair of Living Nerves." The eighth annual award of the President and Visitors' Research Prize of one hundred dollars was made to Drs. A. F. Benton and T. A. White, of the department of chemistry for their paper on "Discontinuities in Adsorption Isotherms."

DR. HENRY E. SIGERIST, director of the Institute of the History of Medicine at the University of Leipzig, has been appointed professor of the history of medicine in the Johns Hopkins University Medical School. He will take up this work on July 1. Dr. Sigerist will succeed Dr. William H. Welch, in whose name the chair was founded at the same time that the William H. Welch Medical Library was established.

DR. LEE MAIDMENT HURD, professor of laryngology, and Dr. John McCloy, clinical professor of laryngology, both of New York University and Bellevue Hospital Medical College, have retired from active service and each will be named professor emeritus. Dr. Richard Atkins Davis, surgeon in charge of otolaryngology service at Bellevue Hospital, has been appointed professor of otolaryngology, effective September 1. Dr. Davis will head a new department of otolaryngology, which will be a combination of the departments of otology and laryngology.

DR. JOHN STEWART has resigned his position as dean of the Medical Faculty at Dalhousie University, Halifax, Nova Scotia.

THE Electrochemical Society has recently awarded the Weston Fellowship in Electrochemistry for 1932-33 to Mr. Marlin E. Fogle, of Diagonal, Iowa. He will continue his studies at Columbia University under the direction of Dr. Colin G. Fink.

THE department of chemistry of the College of Wooster, Ohio, announces the award to John Wellman of the Ralph H. McKee Prize. This prize, provided by Professor McKee, of Columbia University, an alumnus of Wooster, consists of a two-year membership in the American Chemical Society, and is awarded to that student who, at the end of the first semester of his junior year, has the highest standing in chemistry.

AMONG those giving courses in the summer session of the School of Medicine of the University of California will be Dr. J. W. Bridges, professor of abnormal psychology of the McGill University faculty of medicine, and Dr. Mark A. May, professor of educational psychology at Yale University.

PROFESSOR S. O. MAST, of the Johns Hopkins University, recently gave two lectures at Oberlin College; one on "Color in Organisms" and one on "Structure, Locomotion and Response in Amoeba." The lectures were given under the auspices of the department of zoology of Oberlin College.

DR. RALPH PEMBERTON, associate professor of medicine at the University of Pennsylvania and chairman of the American Committee for the Control of Rheumatism, recently gave a clinic on arthritis at the Duke Hospital, and the following week Dr. Warren H. Lewis, of the department of embryology, Carnegie Institution of Washington, conducted a clinic on cancer.

THE guest speaker at the annual meeting of the Toronto Biochemical Society, held jointly with the Toronto Chemical Association, in Toronto, was Dr. R. W. Gerard, of the department of physiology of the University of Chicago. Dr. Gerard spoke on "Energy Relations in Cell Oxidations."

ACCORDING to *Nature* Lord Rutherford opened a discussion on "The Structure of Atomic Nuclei" at a recent meeting of the Royal Society. Dr. J. Chadwick, Dr. C. D. Ellis, Professor R. H. Fowler, Professor J. C. McLennan, Professor F. A. Lindemann and Mr. N. F. Mott were expected to take part.

SECTION O, Agriculture, of the American Association will meet in joint session with the northeastern section of the American Society of Agronomy at the summer meetings of the association in Syracuse, June 21, when they will participate in the program on land utilization. On June 22 the meeting will be held at Geneva, New York, consisting mainly of a visit to the laboratory at the New York Agricultural Experiment Station and to the fields, with a study of the fertilizer experiments, the canning crop investigations and the lysimeter experiments. The dinner and business meeting will be held in Geneva, and on June 23 the group will meet at Cornell University at Ithaca for an inspection of the investigational work of the department of agronomy, especially the field experimental work in agronomy and in plant breeding.

THE twentieth annual meeting of the Eugenics Research Association will be held at the American Museum of Natural History, New York City, on June 4. There will be one session for the presentation of scientific papers and another for the transaction of business.

THE annual meetings of the American Society of Zoologists will be held at Atlantic City on December 28, 29 and 30, inclusive, 1932, instead of on December 27 and 29 as previously announced in SCIENCE. This will mean the opening of the meetings on the second day of the American Association for the Advancement of Science program as usual. Hotel headquarters for the Zoologists will be "The Ambassador," where all the sessions will be held. Special features will be two or three round-table conferences on topics selected from the following list: endocrinology, radiation, chemistry of the cell, morphogenesis, general physiology of the cell.

THE tenth Colloid Symposium sponsored by the committee on the chemistry of colloids of the National Research Council and the colloid division of the Amer-

ican Chemical Society will he held at Ottawa, Ontario, June 16–18, 1932. Dr. Emil Hatschek, of London, England, will be the guest of honor. A program numbering twenty-seven papers has been arranged by the research council committee of which Harry B. Weiser, Rice Institute, Houston, Texas, is chairman.

THE department of zoology at the University of Minnesota sponsored the following symposium of lectures on glands of internal secretion during the week beginning on May 3: "Physiology of the Ovarian Hormones"; "Hormones Influencing the Primate Endometrium," Frederick L. Hisaw, professor of zoology, University of Wisconsin; "The Reactions of the Testis to Experimental Treatment"; "The Internal Secretions of the Testis," Carl R. Moore, professor of zoology, University of Chicago; "The Hormone of the Adrenal Cortex"; "Physiological Studies on the Adrenal Cortical Hormone," W. W. Swingle, professor of biology, Princeton University.

THE council of the International Association of Wood Anatomists has announced the election of Dr. Samuel J. Record, professor of forest products at Yale University, as secretary-treasurer of the association. The association was constituted at a meeting in Paris last July in conformity with resolutions adopted the year before by wood anatomists attending the fifth International Botanical Congress at Cambridge, England. The purpose of the association is to cooperate in a systematic investigation of the woods of the entire world through the pooling of materials, standardization of terminology and descriptions, and the exploration of little known forest regions. The association has a present membership of fifty investigators in eighteen different countries. The executive council consists of eleven members of eight nationalities, and includes two Americans, namely, Professor Record, of Yale University, and Professor Irving W. Bailey, of Harvard University.

RENSSELAER POLYTECHNIC INSTITUTE, Troy, N. Y., ultimately will receive the major portion of the estate of James C. McGuire, engineer, who died December 7, 1930, leaving an estate valued at $1,352,072 net. The residue of the estate will go to the institute after the death of a sister, Miss Mary M. McGuire.

ACCORDING to the London *Times* a new empire center for the scientific study of internal parasites has been established in Canada, with the assistance of a grant from the Empire Marketing Board. New buildings, which will house the Institute of Parasitology, are now being erected by the Quebec Government at Macdonald College, the agricultural college attached to McGill University. The work is to be undertaken at the Macdonald College, and the scheme is being financed for three years jointly by the Empire Marketing Board and the National Research Council of Canada. It marks the first occasion on which the Canadian Government and the Empire Marketing Board have combined to support a joint scheme of research. The *Times* points out that internal parasites are the stock farmers' biggest problems all over the Empire; in Canada alone the annual loss through parasitic infestation is estimated at £4,000,000. It is hoped that the new institute may eventually become an Empire headquarters for the study of internal parasites, somewhat as Onderstepoort, in South Africa, has become recognized as an Empire center for animal diseases research.

FACILITIES for chemical instruction and research at the Michigan College of Mining and Technology, Houghton, were considerably enlarged this spring with the completion of a three-story addition to Koenig Hall, chemistry building. The annex, which with its equipment cost $90,000, adds 13,500 square feet of floor space. Approximately half of this is devoted to five laboratories—chemical engineering, gas and fuel analysis, physical chemistry, qualitative analysis and organic chemistry. The rest of the new structure is used for five instructor's offices, several preparation rooms, sections for photographic and spectroscopic work and three research rooms. Among the apparatus installed in the annex is a horizontal double-effect Swenson evaporator given by the Massachusetts Institute of Technology.

THE New York State Conservation Department has announced the purchase of 24,000 acres of land to be added to the forest preserve. One tract of 21,000 acres in northern Herkimer County, near the Beaver River, is the largest block added to the preserve in recent years. It is extensively wooded with virgin forests. "These purchases," said Henry Morgenthau, conservation commissioner, "show that although the state is obtaining large tracts of land outside of the forest preserve for reforestation purposes, it is not neglecting to preserve itself but is constantly increasing its extent." The other tract of land, just taken over by the commission, consists of 3,000 acres comprising Howland's Island, lying in the Seneca River east of Seneca Falls in Cayuga County. It will be developed into a game refuge or public hunting ground. It consists of meadow land in the Montezuma marshes. It is partly wooded, but most of it is abandoned farm land. The locality is especially suited for pheasants and cottontail rabbits. In addition to Howland's Island proper the purchase includes Campbell or Busk Island and a portion of mainland known as Bluff and Hard Points. It will be developed by the division of Fish and Game of the Conservation Department.

DISCUSSION

RELATIONS OF BIOCLIMATICS TO THE OTHER SCIENCES

As the result of long-continued studies of natural phenomena with special reference to life, climate, seasons and geographical distribution, manuscripts have been prepared for two volumes on a new science of bioclimatics.

This science is new, or at least different from any other branch of the natural sciences, in that it is based on the bioclimatic law and related laws and principles, and that it deals with fundamental principles, systems and methods of applying knowledge of facts and evidence on any subject of life, climate, weather, seasons, geographical distribution and related subjects as recorded in the literature of any branch of science or economic practice related to human interest in general and to local, regional, continental or world agriculture in particular.

Bioclimatics does not, therefore, occupy the field of any branch of the sciences, or duplicate any line of teaching or economic research, but is intended simply to give the results of research on, and the interpretation of, fundamentals which apply alike to all, and to present by means of examples, tables, maps, charts, systems of classification and methods of procedure, by which they may be applied by any research specialist to help solve his specific problems, and especially to serve as a guide to the coordination of certain features of his results, in such a way as to make them available for direct comparison, not only with results attained by other specialists in the same branch of science but with those related to the same general subject in any other branch, and thus contribute to the development of a coordinate system of comparable results for general study and interpretation.

As is well known, the present complexity of major and minor branches, divisions and sections of the natural sciences, with innumerable lines of general and intensive specialization and each developing a more or less different technical language, the old-time naturalist and philosopher has been crowded out of the field and picture. There is no longer any possibility for the naturalist or philosopher, or for any one in a given science, to keep up with or even comprehend the advancements that have been made within recent years in all the sciences.

With the present lack of coordination of methods, or results, with any comprehensive system of laws and principles it is utterly impossible for any one to make a broad comprehensive study and correct interpretation of even the most outstanding results in the major sciences.

It must be generally recognized, therefore, that there is urgent need of some fundamental plan by which the results of various lines of research, relative to a broad subject like agriculture, can be coordinated with some system of basic principles and methods by which comparative study and interpretation can be made towards solving some of the really big problems in agricultural research and economic practice.

The principal object in the development of the science of bioclimatics has been to contribute to this need, and it is believed that it has been attained, at least to the extent of serving as a basis for further development towards an ideal system.

The system as developed is based on certain fundamental laws and principles which apply alike, or in a similar way, to any line of research in any science requiring a general or specific consideration of the basic elements of time, temperature and distance in the relations between life, climate, seasons and geographical distribution.

Thus taking any minor or special subject, as for example a given species of injurious beetle as representing the major science of biology, the major branch zoology and its division entomology, order Coleoptera, the family Scolytidae as a special field of research, forest entomology as the special section of economic entomology, and the southern pine beetle as the insect; every detail in the study of its seasonal activities or seasonal history involves elements of the fundamental laws of cause as manifested in the motions of the earth and the energy of the sun, and of effects in time and the seasons, climate and weather, distribution by distance in degrees of latitude, longitude, and feet of altitude, events in the seasonal development of the insect and its host plant, are all coordinate elements of the causes and effects of a bioclimatic complex. The normal temperature of the year and of the warmest and coldest months of the nearest meteorological station indicate the local type of climate and type of bioclimatic zone, the dates and periods of the seasonal events of the insect and its host plant indicate the type of season, the geographic position of the local area in which the insect occurs will indicate its latitude and altitude distribution, while its control depends on the selection of the proper time in the season for the application of control measures, which will differ with distance north, south, east or west of a given local area, as it will with higher and lower altitudes in the same general area.

Thus, this or any other form of life represents the ultimate effects of all of the major and minor laws and factors of cause, or of the causation complex, from the motions of the earth and the energy of the sun down to the local climate, weather, seasons and zonal type, and the ecological type of its immediate

environment. So that, in order to know about a single form of life, it is necessary to know about the laws and principles which have governed its origin, evolution, survival and dispersal within its present geographical limits, and its present relations to all other forms of life coming within the same zone of climatic influence. In fact, "to know all about any one thing in nature it is necessary to know all about everything," which, of course is far beyond the capacity of the human mind individually or collectively. When, however, it is known from the accumulation of knowledge and special original research that there are certain fundamental major and minor laws and factors of nature, the effects of which are represented on the surface of the earth by the phenomena of life, seasons, weather and their variation in character or type with geographic distance, and that with the development of a comprehensive system of coordinate bioclimatic elements and of principles and methods of application the records of the bioclimatic elements of any geographic position can be analyzed, the major and minor bioclimatic zones and the zonal, climatic, seasons and weather types it represents can be interpreted. So that a large part of the essential knowledge on which to base specific scientific research on any form of life or any related subject can be made available to the research specialist. In other words, the specalist can take the preliminary interpretations of the fundamental laws and principles, which are represented alike by all of the elements of the local phenomena, and begin his work where his immediate problems of supplying additional information begins.

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PERIGLACIAL PHENOMENA IN THE PUGET SOUND REGION

IN the Arctic and sub-Arctic lands and also in the high mountains intensive frost action produces distinctive structures in the surface soil. These "reticulated" or "cellular" soils have been described from many localities by me and by many other observers.[1] The published discussion of this subject by Bryan[2] and a recent conversation with him have recalled to my attention observations made some years ago in the Puget Sound region. Here on the prairies in the vicinity of American Lake, southwest of Olympia, Washington, are gravel outwash plains of the earlier ice advance. These localities were outside the border of the last (Wisconsin) ice and, therefore, must have endured a periglacial climate. The most significant features are segregations of gravel and soil that have a reticulated pattern. Over large areas the surface is divided into approximately equidimensional patches of soil nearly clear of stones that are separated from each other by narrow strips of gravel and boulders having an open texture and little or no interstitial soil. As a general rule the soil patches stand higher than the boulder septae. In many places the margins of the boulder septae are higher than their centers. Major lines of boulder concentrations persist for long distances and branch up slope in characteristic drainage arrangement. In other words, one accustomed to the Far North finds here, under a present genial climate, a thoroughly familiar set of features, identical in every respect with the products of sub-Arctic frost rearrangement of mixed alluvial materials.

There are also areas in which the gravels are hidden by broad parallel ridges of black soil. These were developed at the time of glacial recession but are not indicative of any peculiarities of the climate of the time. Such ridges are normal forms of deposition from broad sheet-flow of silty or turbid water and are developed as readily in warm climates as in cold. Flood deposits in the alluvial valley of the Mississippi of both modern and fairly ancient origin show these same forms. The unusual dark color of the ridge soils of the Puget Sound region is the result of the growth and decay of the common brake.

The existence near Olympia of reticulated soils that testify to the existence of a Wisconsin periglacial climate should lead to search for other similar phenomena within the area and to further use of such criteria in the interpretation of the earlier glacial deposits along lines of attack similar to that already initiated in the Central States.[3]

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MISSISSIPPI RIVER COMMISSION,
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METER IN COMPOSITION

IN the issue of SCIENCE for October 30 is an interesting note by G. S. Fraps on "Hybrid Words." In closing, he says: "The English language would be in better shape if some people knew less Greek and Latin." Perhaps it would be better to say that the English language would be in better shape, if everyone, especially scientists, knew more of these languages and would be more careful and less pedantic in using the very little they usually know. Hybrids of all kinds offend good taste. Even the lovable

[1] "The Yukon-Koyukuk Region, Alaska," U. S. Geol. Survey Bull., 631, pp. 75–82. 1916; B. Hogbom, "Uber die geologische Bedeutung des Frostes," Geol. Inst. Uppsala, Bull., vol. 12, pp. 258–390, 1913; W. Salomon, "Arctische Bodenformen in dem Alpen," Heidelbergen Akad. Wiss. Naturw. Kl. Sitz-Ber., Pt. 5, pp. 1–30, 3 pls., 1929.

[2] Kirk Bryan, "Glacial Climate in Non-glaciated Regions," etc., *Amer. Jour. Sci.*, 5th ser., vol. 16, pp. 162–164, 1928. Also "New Criteria Applied to the Glacial Geology of Southeastern Massachusetts," *abst.*: Geol. Soc. Amer. Bull., 1932.

[3] G. F. Kay, "Origin of the Pebble Band on Iowan Till," *Jour. Geol.*, vol. 39, pp. 381–385, 1931.

mongrel dog can not be admitted into good canine society. A silk hat must not be worn with any kind of a coat. Every one of refinement is careful to have each article of dress conform to a certain scheme. In the army and navy an officer may on certain occasions wear either all citizen's clothes, or all uniform. He must not wear his uniform cap with a gray sack suit.

The same principle holds true with regard to cultivated taste in the formation of words. Just as one does not generally approve of racial mixtures, so good taste is offended by mongrel words which are the misbegotten offspring of linguistic miscegenation. Doctors seem to be the worst offenders in this matter. They know little or no Greek, but they miss no opportunity to work in what little they think they know in order to mystify or impress. They are devoted, for instance, to hyper and hypo in place of super and sub in composition with Latin stems. All doctors, I am told, say "hypersensitive" and "hypertension." This sounds more learned and is less likely to be understood than supersensitive and supertension. In fact, doctors seem to be quite "hyperstitious" about Greek and somewhat "hypercilious" in the use of it.

But some mixtures are admissible. Greek words have been thoroughly naturalized as Latin, and both Greek and Latin words have been admitted into good English society. The ending "ology" is an example. We even have roentgenology. Many are violently opposed to the anti-prohibitionists, but no one objects to the word. The advocates of "Shapometer" may find some comfort in the fact that meter seems to have been adopted as a legitimate English word. Originally Greek, it was first adopted into Latin and we have many Latin stems combined with it. In the metric system we have millimeters as well as kilometers. Then, as signifying an instrument of measurement, we have it in all sorts of combinations. In voltameter and voltmeter the first element is an Italian proper name. We already have speedometer, why not shapometer? People might well be pardoned for using this last combination, provided they will refrain from accenting kilometer on the second syllable.

Many thousands of our boys went to France who had never used the metric system. There they encountered kilometer and naturally made it rhyme with the familiar speedometer. The sad thing is that many scientists have now fallen into this error. Soon we shall have centimeters and millimeters accented in the same way. But one is not easily surprised at any departure from linguistic orthodoxy when a learned scientist in your columns not long ago aired his learning by saying grandly "cacodorous" and "polyvalent" for the perfectly nice words "malodorous" and "multivalent."

GEORGE W. LAY

CHAPEL HILL, N. C.

ACADEMIC FREEDOM IN SPAIN

DR. NONIDEZ' reply to my letter of April 15 is a typical example of "it depends on whose ox is gored." The case of nine Italian professors out of over twelve hundred who are forbidden to teach in state universities because they refuse to take an oath of allegiance to the state is an attack on academic freedom; the case of perhaps twelve hundred Spanish professors who are forbidden to teach in private schools because of a fictitious vow is not an attack on academic freedom.

I too received part of my education in Spain and know conditions there, but I had the good fortune to have been born and reared in the United States which is a republic in fact and not merely in name. I agree with Dr. Nonidez that "the suppression of the Jesuits with the advent of the new order was a foregone conclusion," but not for the reason he assigns. The Jesuit fourth vow has nothing to do with allegiance to a foreign power. It has a very specific object, and one only, and that is to go on the missions when commanded by the Pope as head of the Church. That this vow was a pretext to cover a gross injustice is shown by the fact that, unlike the communists of whom the writer speaks, the Jesuits were not deported as they should have been had they vowed allegiance to a foreign power, but only deprived of their right to teach and hold property.

The fact that the Jesuits were formerly exiled, even by "His Most Catholic Majesty, Charles III," is no excuse for "less severe" treatment by a so-called republican government.

P. H. YANCEY, S.J.

DURABLE FILMS

THE Aristogenic Association is engaged in making records of the characteristics of men thought to be of great service to humanity. An endeavor is being made to make the records as objective as possible, *i.e.*, to present their own evidence. Therefore the motion picture, photograph and x-ray are extensively employed. Since it is desired to preserve a copy of these records intact for release at the end of a century, they must be durable. There is, however, some doubt as to the best methods of preserving them for so long a time. The usual sources of information are indecisive.

We should appreciate any useful data or suggestions.

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SPECIAL ARTICLES

THE DEFLECTION OF LIGHT IN THE SUN'S GRAVITATIONAL FIELD

AMONG the various expeditions sent out to observe the total solar eclipse of May 9, 1929, that of the Potsdam Observatory (Einstein Stiftung) seems to be the only one which obtained photographs suitable for determining the light deflection in the sun's gravitational field. Two instruments were used, but so far only the results of the larger one, a 28-foot horizontal camera combined with a coelostat, have been published. The three observers, Freundlich, von Klüber, von Brunn,[1] claim that these observations (4 plates containing from 17 to 18 star images each) lead to a value of 2″.24 for the deflection of a light ray grazing the sun's edge; a figure that deviates considerably from the results of the 1922 eclipse, and which is in contradiction to Einstein's generalized theory of relativity. In view of the importance and general interest attached to this problem, a few critical remarks on the Potsdam observations and their reduction should not be out of place here[2]:

(1) The accuracy claimed for the Potsdam result is somewhat illusory. A more liberal discussion of the residuals would lead to a probable error of at least ± 0″.10 (mean error ± 0″.15), 50 per cent. larger than that given by the observers; but even this does not fully take into account the uncertainty in the adopted scale difference of the plates.

(2) The star field of the 1929 eclipse was unfavorable, for of the 18 stars bright enough to be photographed on the Potsdam plates, 17 were located on one side of the sun and only one star on the other side. That is, we may draw a straight line through the center of the sun such that a single star is on one side of the line and the other 17 stars are on the other side. This extremely unsymmetrical star distribution has the consequence that the light deflections to be determined depend to a high degree on the plate constants used in the reduction; and five such constants for each plate had to be derived from the star measures.

(3) The Potsdam reduction is based on the assumption (in accord with the Einstein theory) that the light deflection is inversely proportional to the star's angular distance from the sun's center. However, the deflections determined by the Potsdam observers are not in accord with this Einsteinian requirement. When the stars are arranged according to their angular distances from the sun's center, a systematic run in the radial components of the residuals is apparent. Among the 6 stars nearest to the sun, 5 have negative residuals, while of the 6 most distant ones 5 have positive residuals. This leads to the conclusion, either that the Potsdam observations are affected by a systematic error, or that the assumption on which the reduction is based is incorrect. Ludendorff[3] has investigated the question of a systematic measuring error; the evidence presented in the following indicates that the fault lies in the scale determination.

(4) In our problem the most important correction to be applied to the differential measures of an eclipse photograph and a photograph of the same (eclipse) group of stars obtained at night for comparison purposes several months before or after the eclipse date is the scale difference between the two plates. The Potsdam observers tried to determine this scale difference independently of the star observations. By means of a collimating telescope, a reseau of fine lines was copied on each of the eclipse plates as well as on the comparison plates, and the observers assumed that the angle corresponding to a reseau interval remained unchanged during the period of from 5 to 7 months which elapsed between the eclipse and the comparison observations. This assumption, however, has no sound foundation. The temperature at the time of the comparison observations (secured at night) was on the average 5° C. lower than during the eclipse, and the tube of the collimating telescope, and in consequence the intervals between the reseau lines recorded on the eclipse and comparison photographs, must have suffered changes due to temperature changes. In fact, the probable temperature effect neglected by the Potsdam observers would be of the right sign and order of magnitude to account for the excess of the observed light deflection over the requirements of the Einstein theory.

(5) Originally the Potsdam expedition in its plans had foreseen the possibility of a change in the collimator-reseau combination. A duplicate horizontal camera was utilized to photograph, at the time of the eclipse, another star field far to one side of the eclipsed sun, and therefore not subject to appreciable Einsteinian deflections; the photographs thus secured, when compared with photographs of this star field obtained at night, to be used in checking or measuring the effects of such a change. Unfortunately the optical qualities of this second telescope were somewhat defective (perhaps because of strains in the objective at the time of the comparison observations), so that photographs of the reseau's straight lines show optical distortion. The observations of the second tele-

[1] Abhandl. d. Preuss. Akad. d. Wissensch., 1931, Math. Phys. Kl. No. 1; *Zeitschr. f. Astrophysik*, 3, 171, 1931.

[2] A fuller account is being published in the *Zeitschrift für Astrophysik*.

[3] *Astron. Nachr.*, 244, 321 and 415, 1932.

scope can therefore not serve their purpose, and without this check the Potsdam scale determination deserves no confidence and should be rejected.

(6) The Potsdam measures can nevertheless be utilized for the study of light deflections, if the scale correction is determined with the other plate corrections from the star observations themselves, a procedure similar to that employed at the 1919 and 1922 eclipses. On account of the unsymmetrical distribution of the stars it is in this case important that all plate constants should be redetermined when the scale value is added as another unknown.[4] A new reduction of the Potsdam measures made by me on this basis leads to a value of:

$$E = 1''.75 \pm 0''.13 \text{ (p.e.)}$$

for the light deflection at the sun's limb, which is in precise agreement with the Einstein theory, as well as in good accord with the earlier observations. The small probable error proves the excellent accuracy of the Potsdam *measures* and entitles this result to carry some weight among the former determinations of light deflection (see Table I).

(7) The residuals from the new solution are much more satisfactory than those of the original reduction. The law of inverse proportionality of the light deflections and the angular distances from the sun's center is now quite well fulfilled; the radial components of the residuals no longer show the systematic run mentioned under (3); and the sum of their squares is reduced to less than half its former amount.

(8) In the Potsdam publication objections are raised against the reduction of the 1922 observations made by the Lick Observatory expedition, and a new reduction of the Lick observations undertaken at Potsdam is mentioned as giving much larger values for E (around 2".2). Closely examined, the Potsdam formula proposed for the solution of the 1922 observations, *though differing in form,* is equivalent to the one used by the Lick observers. The difference in method lies merely in the fact that the Potsdam observers arbitrarily divided the stars into two groups according to their distances from the sun's center, using the outer stars only for the scale determination, and the inner ones only for the light deflection; whereas the Lick observers, by the method of least squares, derived both unknowns simultaneously from all stars. Check calculations showed in fact that the two methods give practically identical results.

(9) The larger result which the Potsdam observers obtain from the Lick observations is thus not due to any difference in the method, but to an unsuitable choice of weights and the arbitrary exclusion of certain stars. Instead of using the weights established by the observers, the Potsdam authors simplified their calculations by rejecting stars having smaller weights than one eighth of the maximum weight, and giving all other stars equal weights, regardless of the number of plates on which they were measured. But even if this remarkable weighting practice is adhered to, it does not lead to the large value of the light deflection quoted in the Potsdam publication. The latter could only follow (provided there are no mistakes in the

[4] A solution of the Potsdam residuals for Einstein term and scale correction alone was made by Jackson (The Observatory 54, 292, 1931), which led to a value of 1".98. The considerably smaller result of our complete solution is mainly due to the change in the zero point, which must accompany any alteration in the scale value and the Einstein term.

TABLE I

DETERMINATIONS OF LIGHT DEFLECTION IN THE SUN'S GRAVITATIONAL FIELD

Eclipse	Observing station	Telescope Aper.	Telescope Foc. l.	No. of plates	No. of stars	Light deflection sun's limb	Prob. error	Remarks	Observers
1919 May 29	Sobral	4-in.	19-ft.	7	7	1".98	±".12		Dyson
	Sobral	8	11	16	6–12	(0.86)	± .1	(1)	Davidson
	Principe	8	11	2	5	1.61	± .3		Eddington
1922 Sept. 21	Wallal	6	10	2	18	1.74	± .3		Chant, Young
	Wallal	5	15	4	62–85	1.72	± .11	(2)	Campbell
		4	5	6	134–143	1.82	± .15	(3)	Trumpler
	Cordillo-Downs	3	5	2	14	1.77	± .3		Dodwell, Davidson
1929 May 9	Takengon	8	28	4	17–18	1.75	± .13	(4)	Freundlich, v. Klüber, v. Brunn
	Weighted mean					1".79	±".06	(5)	

Remarks: (1) Poor focus, rejected by observers; not used for the mean.
(2) If "corrected" for check-field residuals: 2".05.
(3) If "corrected" for check-field residuals: 1".71.
(4) New reduction by Trumpler; original reduction by observers: 2".24.
(5) Weights according to p.e. of individual results; p.e. of mean from sum of weights.

Potsdam numerical calculations) if additional stars, mostly those giving negative residuals, were rejected. Such an arbitary exclusion of observations, however, is against the rules of the theory of errors, and it deprives the result of any value.

(10) In the publication of the 15-foot camera observations, secured by the Lick expedition of 1922, attention was drawn[5] to a run in the residuals of the check star field (photographed on the nights before and after the eclipse). Since the origin and reality of these small residuals are quite doubtful, the observers based their final result (1.″72) on the observed (uncorrected) star displacements D_1. Freundlich, von Klüber, and von Brunn, on the other hand, give preference to the figure 2.″05 obtained from the star displacements D_2 which are "corrected" for these uncertain residuals of the check field. It is true that this choice is a matter of personal judgment, but whatever the choice, the same procedure should be employed for both pairs of instruments used by the Lick expedition. The adoption of the Potsdam view-point would require that the observations secured with the Lick pair of 5-foot cameras[6] be similarly "corrected" for the check-field residuals, and this would lead to a slightly smaller value (1.″71). The mean of the results given by the two pairs of instruments would then be 1.″9, which still agrees with Einstein's prediction within the limits of permissible observational error.

SUMMARY

The scale determination for the 28-foot camera, on which the published result of the Potsdam expedition is based, is unsatisfactory and should be rejected. A new reduction of the Potsdam measures, in which the scale correction is determined from the star observations, yields a result of $E = 1.''75 \pm 0.''13$ for the light deflection at the sun's limb, and considerably reduces the residuals of the observations. The objections of the Potsdam observers against the reduction of the 1922 observations are not valid, and there is no reason to change the results published by the Lick observers. The various measures of light deflection at the sun's edge thus far available are listed in the following table; their weighted mean is $1.''79 \pm .''06$.

ROBERT J. TRUMPLER

ZURICH (SWITZERLAND), MARCH 29, 1932

NORMAL TISSUES AS A POSSIBLE SOURCE OF INHIBITOR FOR TUMORS[1]

THE presence of an inhibitor associated with the causative agent of a chicken tumor has been reported in recent communications. While the tumor agent is more or less species specific the inhibitor from the sarcoma has been found to affect definitely a transplanted sarcoma of mice. The results of these observations and others on the properties of the causative agent led to the suggestion that the mechanism involved in the induction and growth of the chicken tumor may be an unbalanced but similar mechanism to that which controls growth and differentiation of normal tissues. This conception led to attempts to separate the hypothetical stimulating and retarding factors from active normal tissues. We have discussed elsewhere the limited evidence indicating the possibility of inducing malignant transformation by means of the growth-augmenting factor. The present paper is a report of experiments which suggest that an inhibiting factor may be extracted from certain normal tissues.

The inhibitor or balancing factor might be expected to occur where there is a greater concentration of the stimulator. Therefore we have used active tissues as the source of our test materials. Preliminary experiments with extracts of whole fresh embryos and placenta of the mouse, treated in the same way as the chicken tumor extract, *i.e.*, heated to 55° C. for 30 minutes, had little influence on either transplantable carcinoma or sarcoma of the mouse. Profiting by the experiments with chickens, where the tumor desiccate yielded more definite amounts of the inhibitor, we changed the method to the following:

Method: The test tissues consisted principally of placenta, whole embryo, embryo skin and skinless embryo of the mouse. The tissues were macerated, spread in thin layers in a sterile dish, frozen and dried *in vacuo*. These desiccates were ground to a fine powder, extracted with a small amount of water, centrifuged and the supernatant fluid tested on tumors. The carcinoma used for inoculation was cut up into the usual size grafts and part of these immersed in the suspension made from the dried tissues and part in normal salt solution for controls. Usually two or three nicks were made in the grafts to give a greater area of exposure to the fluids. The time of contact allowed was only that required to load the grafts into trocars for inoculation. With the Crocker sarcoma 180 a suspension of the cells was made by forcing the tumor through a fine grill and 1 cc of the cells suspended in 3 cc of salt solution. This suspension was added to an equal amount of the tissue extract and 0.05 cc injected immediately into mice. For the controls the suspensions were diluted in the same proportion with Ringer's solution. The treated tumor was inoculated into one groin and the control into the other. Additional mice were inoculated with

[5] *L. O. Bull.*, 11, 54, 1923.

[6] *L. O. Bull.*, 13, 130, 1928.

[1] From the Laboratories of the Rockefeller Institute for Medical Research.

the control material alone. In some experiments the suspensions prepared from dry tissues were heated at 52° for 30 minutes, but as this treatment had little effect on the results they will not be presented separately. The outcome of eight experiments in which desiccated skin from mouse embryos was the test material are given in Table I.

TABLE I

Material inoculated	Number inoculated	Number negative	Per cent. negative
Carcinoma No. 63 plus extract embryo skin	128	74	57.8
Carcinoma No. 63 plus Ringer's solution	164	29	17.7
Sarcoma No. 180 plus extract embryo skin	40	1	2.5
Sarcoma No. 180 plus Ringer's solution	59	0	0

The second material tested for possible inhibiting action was desiccated mouse placenta. The results with the two tumors are shown in Table II.

TABLE II

Material inoculated	Number inoculated	Number negative	Per cent. negative
Carcinoma No. 63 plus extract of placenta	158	98	62
Carcinoma No. 63 plus Ringer's solution	234	49	20.9
Sarcoma No. 180 plus extract of placenta	86	0	0
Sarcoma No. 180 plus Ringer's solution	129	1	0.7

The inhibiting action of the extracts was shown not only by the low percentage of takes resulting from inoculation of the carcinoma grafts treated with the extracts, but also by the fact that the tumors that did arise from these inoculations were on the average much smaller than the controls. It is evident that neither of these extracts tested had any retarding action on Mouse Sarcoma 180. Extracts of fresh tissues tested included whole embryo, embryo skin, skinless embryo and placenta; those of desiccated tissues, whole embryo and skinless embryo. None of these extracts, heated or unheated, had any significant effect on either of the tumors tested, nor on another sarcoma of the mouse (S/37). A few preliminary experiments on the local injection of these extracts about an established tumor have shown no evidence of retarding growth.

The principal value of the general observation is the possible light thrown on the nature of the mechanism involved in malignancy. The relation of this factor from normal tissues to the inhibitor from the chicken sarcoma will be discussed in a subsequent paper when more definite information is available.

JAMES B. MURPHY
ERNEST STURM

META-AMINO PARA-HYDROXY PHENYL ARSINE OXIDE AS AN ANTI-SYPHILITIC AGENT

THIS trivalent arsenical preparation, meta-amino para-hydroxy phenyl arsine oxide, studied by Ehrlich and Bertheim, later by Voegtlin and others, has generally been thought to be the most important effective breakdown product of the arsphenamines. It is relatively toxic and on this account its use has been heretofore limited to purely experimental fields. Our own theoretical interests led us to study this substance first as a trypanocide, then later in experimental syphilis. We soon found that in experimental trypanosomiasis, the therapeutic index was relatively very high compared to most other effective agents. In rabbit syphilis, we found the therapeutic index to be higher than for any other single antisyphilitic agent known to us. So far as we are aware, it had never received a trial in the treatment of human syphilis.

We have felt for some time that absolute toxicity alone is without special significance, but that the ratio of curative dose to the toxic dose furnishes real evidence of promise. On the basis of abundant data obtained in our laboratories, we readily enlisted the interest of Drs. W. F. Lorenz and W. J. Bleckwenn, of our Department of Neuropsychiatry, and Drs. O. H. and H. R. Foerster, R. L. McIntosh, and L. R. Wieder, of our Department of Dermatology. Complete reports of clinical investigations in the use of this drug will be made in due time by our clinical colleagues. Suffice it to say at this time that sixty patients have received, collectively, a total of seven hundred intravenous injections of this drug in quantities varying from 5 up to 130 milligrams per dose. The usual dosage ranges from 30 to 60 milligrams for the single dose.

Clinically, the results have been exceedingly promising, both in therapeutic effects and freedom from toxic manifestations. We fully realize the necessity, however, of a very careful and prolonged study before a full report can be made on questions of thoroughness of disinfection, optimal dosage, freedom from possible serious toxic manifestations, and practical utility in the treatment of syphilis in its several stages, when used alone and in conjunction with mercury or bismuth.

We have been designating this drug as "158," or more or less tentatively by the name *Mapharsen* from (m)eta-(a)mino-(p)ara-(h)ydroxy (ars)ine oxide. This drug was first prepared for us by Professor C. S. Hamilton, of the University of Nebraska, and later by the Research Department of Parke, Davis & Com-

pany, which has been kindly supplying the larger quantities necessitated by more extensive and intensive studies.

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AIRPLANE OILING TO CONTROL MOSQUITOES[1]

THE airplane has already shown its usefulness in dusting large swamp areas with Paris green[2,3] in control of *Anopheles* mosquito larvae. In New Jersey swamps and marshes, where the larvae of the prevailing species of mosquitoes are primarily bottom feeders, Paris green or any other arsenical dust does not produce efficient control, except when applied in such large quantities as to become an actual menace of poisoning animals and men. This danger is especially feared on mosquito breeding areas, located in close proximity to congested cities and towns. Experiments with other dust larvicides, such as various toxic oils and tar hydrocarbons incorporated in inert carriers such as kaolin, peat moss, sawdust, etc., have thus far not proven successful.

While these experiments are in progress, the mosquito control workers in New Jersey and in other states are still confronted with many large areas of swamps and marshes which can not be successfully drained and which are inaccessible from land for mosquito eradication.

In view of the fact that these mosquito breeding areas can not be efficiently oiled from land, the possibility of applying oil or liquid larvicide by the aid of an airplane has presented itself. Accordingly, experiments were carried out during the summer of 1931, the results of which are here presented.

EXPERIMENTAL

For this purpose an airplane was procured from the Unger Aircraft Corporation, located at Hadley Flying Field, New Jersey, and was equipped with the necessary apparatus for the experiment. Two tanks, of about 50 gallons capacity each, were installed in the forward cockpit of the plane and were connected to a steel pipe 3 inches in diameter. This pipe extends along the bottom of the fuselage throughout the length of the plane, terminating just below the rudder in a cross pipe, 7 feet long and 1½ inches in diameter. This horizontal pipe is perforated with holes ranging from ⅛ to ¼ of an inch in diameter and serves the purpose of a nozzle from which the liquid flows out.

A valve, placed at the rear end of the longitudinal pipe, and operated by the pilot from his cockpit, controls the flow of the oil. This entire equipment is removable and the plane can be used for other flying purposes. The actual application of the larvicide is carried out in the following manner. As soon as the loaded plane reaches the area to be treated the pilot is warned by flags or signals, previously agreed upon, where the larvicide should be sprayed. The pilot then swoops down as low as possible within safety limits and releases the valve. The liquid flows out by the force of gravity as a fine spray, depositing a thin film on the breeding areas.

By this method both pyrethrum larvicide[4,5] and oil were tested in Morris and Middlesex Counties. The results thus far obtained have shown that on a still day when there is no appreciable wind to blow away the larvicide from its course, a killing film of oil or larvicide is deposited on the surface of the breeding area.

The last two experiments carried out on the Cheesequake salt marsh meadow and on the Florham upland meadow, have produced very encouraging results. Practically complete kill of larvae and pupae in each case was obtained. About 8 acres of the Florham meadow were covered with a killing film of oil in about 40 minutes. The amount of oil required for this purpose was about 140 gallons. The cost of the application, as estimated by several field men experienced in mosquito control work, was found to be cheaper than hand oiling.

While this problem is still under investigation, the preliminary results thus far obtained indicate that on certain large breeding places where the entire area has to be oiled, successful control may be obtained by applying oil or other liquid larvicides from a properly equipped airplane. This method, however, may prove uneconomical on such marshes or swamps where the breeding is scattered and where coverage of the entire area is not necessary.

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NEW BRUNSWICK, N. J.

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Department of Entomology.

[2] W. V. King and G. H. Bradley, "Airplane Dusting in the Control of Malaria Mosquitoes," U. S. D. A. Department Circular No. 367, 1926.

[3] L. L. Williams and S. S. Cook, "Paris Green Applied by Airplane in the Control of *Anopheles* Production," Public Health Report, p. 459, Reprint No. 1140, 1927.

[4] J. M. Ginsburg, "Studies of Pyrethrum as a Mosquito Larvicide," Proceedings of the 17th Annual Meeting of the New Jersey Mosquito Extermination Association, p. 57, 1930.

[5] R. L. Vannote and J. M. Ginsburg, "Practical Application of Pyrethrum Mosquito Larvicide," Proceedings of the 18th Annual Meeting of the New Jersey Mosquito Extermination Association, p. 111, 1931.

THE NATIONAL ACADEMY OF SCIENCES

PAPERS PRESENTED AT THE WASHINGTON MEETING

AT the annual meeting of the National Academy of Sciences, held in Washington on April 25, 26 and 27, the following papers were presented:

The cure of drug addicts: WILDER D. BANCROFT, R. S. GUTSELL and J. E. RUTZLER, JR. Morphine coagulates albumin, and sodium rhodanate should therefore counteract the effects of morphine. We have shown that it does for rabbits, dogs and men. Since sodium rhodanate is said to increase the activity of the tuberculosis bacillus, sodium rhodanate should not be given to a tuberculosis patient. If a patient has taken morphine to minimize the pain from some such disease as cancer, there is nothing permanent to be gained by curing the drug habit unless one can alleviate the pain. From experiments on six patients we believe that it is possible to cure any drug addict who is not tuberculous, who does not have a weak heart, who does not suffer from a pain-producing disease and who really wants to be cured. This last is very important. If a man is down and out after the treatment, he will probably relapse. If he is a criminal addict and his friends take drugs, he will probably relapse. He will not relapse because of tremendous depression or an intense craving; and he can pull himself out again without much trouble if he wishes to. One patient did. While we believe that we have proved that it is not necessary for anybody without the special complications to remain a drug addict, we do not feel that the details of treatment are standardized. Our patients all have some delirium, which is probably unnecessary. Since many drug addicts have psychoses, it is also necessary to cure the psychosis, which means that this work is tied up with the treatment of the insane.

A study of van der Waals forces between tetrahalide molecules: J. H. HILDEBRAND and J. M. CARTER. A knowledge of van der Waals forces is essential to an understanding of many problems involving properties of gases, liquids and solids and the transitions between them. The approach of the authors is chiefly through the problem of solubility. In order to avoid dipole forces it was desired to investigate molecules of the highest possible symmetry, and for this the tetrahalides appeared most suitable, owing to the variety offered by their molecular sizes and fields. The authors have worked with the liquid tetrachlorides of carbon, titanium, silicon and tin and the tetrabromides of the last two. The properties thus far measured have been the expansion on mixing and the change in pressure with temperature at constant volume, the latter property for the six pure liquids and for eight of their mixtures. From this can be calculated the coefficient of energy with respect to volume, $(\partial E/\partial v)_T$. This is given with great accuracy for the range studied by the van der Waals function, a/v^2. The values of a are as follows, in atmospheres times liters squared: carbon tetrachloride, 31.21; silicon tetrachloride, 34.00; silicon tetrabromide, 53.36; titanium tetrachloride, 41.90; stannic chloride, 44.84; stannic bromide, 64.79. These values are only approximately simple functions of the molecular dimensions, even for the chlorides. Values for eight mixtures were measured and their relation to the values for the pure liquids discussed. The value of a between different molecules is given by the van der Waals relation $a_{12} = \sqrt{a_1 a_2}$ with a maximum disagreement of 2.2 per cent. However, the agreement between observed and calculated values for the solutions is better if the function $v(\partial E/\partial v)_T$ is regarded as additive. The maximum deviations for both relations as well as the maximum expansion on mixing is shown by the tetrachlorides of carbon and tin, although these do not represent extreme members of the series according to any of the properties considered. This is taken to indicate that the tin-halogen bond is more or less polar. The vapor pressures of these solutions are being measured in order to test theoretical connections between intermolecular forces and deviations from ideal solution laws.

Some new contributions to nucleic acid chemistry: P. A. LEVENE, R. S. TIPSON and S. A. HARRIS. The complex nucleic acids are composed of several nucleotides. Each nucleotide is, in turn, a glycoside of ribosephosphoric acid. A complete knowledge of their structure requires information as to the ring structure of the riboside and the location of the phosphoric acid radicle on the sugar. The first of these two problems has now been solved satisfactorily in the following way: Adenosine was acetylated and the acetyl derivative was methylated. The trimethyl ribose obtained from it differed in optical rotation and in other physical properties from the trimethyl-d-ribose derived from the normal-methyl-d-riboside and hence did not possess the pyranose structure. Furthermore, on rigorous oxidation it yielded (i)-dimethoxy succinic acid, thus establishing the furanose structure of the nucleoside. For the solution of the second problem it was necessary to find a method for partial hydrolysis of the nucleotides in a way which would yield ribosephosphoric acid. After many failures the following method was devised. Guanylic acid was converted by diazotization into xanthylic acid. The latter on standing in aqueous solution at its own pH at 50° yielded the desired substance. In the substance obtained in this manner the location of the phosphoric acid residue is restricted to one of two possible positions, namely, carbon atoms 2 or 3 of the sugar.

The chemical bond: GILBERT N. LEWIS.

Combination of carbon monoxide and oxygen under the influence of radon: S. C. LIND and CHARLES ROSENBLUM. When alpha particles traverse a gas or mixture of gases capable of reacting chemically under this in-

fluence, the amount of reaction is proportional to the ionization produced in the gas phase. It has been found that when a foreign gas is also present, its ions contribute to the amount of chemical action in the same degree as if they were ions of the reactant gas. Carbon dioxide, however, appeared to behave abnormally. In the oxidation of CO or CH_4 by oxygen, the CO_2 generated did not appear to contribute to, or disturb, the course of the reaction even when the quantity of CO_2 produced exceeded the quantity of the reactants by several fold. This abnormality has been examined by adding an excess of CO_2 to a mixture of $2CO + O_2$ before any reaction had taken place. It has been found that CO_2 ions do have an enhancing effect, but one that is only about 14.5 per cent. efficient. In addition, the effect of recoil atoms has been examined in this reaction. Its magnitude is that predicted from the synthesis of water by radon after taking into account the differences in stopping power, specific ionization and the fact that gaseous CO_2 does not condense like H_2O vapor and, therefore, serves to screen partially the recoil atom effect, thus diminishing its intensity. The influence of the size of the reaction vessels (spheres) has also been investigated with a result which confirms the law of the inverse square of the diameter which results from considering the linear paths of the alpha particles in small spheres and the pressure change produced by the chemical action.

The rediscovery of nitryl chloride: WILLIAM ALBERT NOYES. In 1862 Richard Müller gave an accurate description of the preparation, properties, analysis and determination of the vapor density of nitryl chloride, NO_2Cl. Several other chemists claimed that they had obtained the compound, but in 1905 Gutbier and Lohmann obtained only nitrosyl chloride, NOCl, in their attempts to repeat the work of former observers and came to the conclusion that the compound does not exist. During a study of the reaction between nitrogen tetroxide and nitrogen trichloride evidence was obtained indicating the presence of nitryl chloride among the products of the reaction. A repetition of some of the work of Richard Müller has also given a small amount of the compound.

Resonance of a molecule among several electronic structures: LINUS PAULING (introduced by A. A. Noyes). A study of energy relations and interatomic distances has shown that many molecules in the normal state can not be represented by a single electronic structure of the Lewis type, but instead resonate among several. The recognition of this phenomenon clarifies a number of previously puzzling points relative to the correlation and explanation of physical and chemical properties.

Experiments on the nature of the structural unit of metals: ALFRED STOCK (by invitation). On the electrolysis of solutions of the boron hydrides B_2H_6, B_4H_{10} and $B_{10}H_{14}$ in liquid ammonia. This work is a section of the investigations carried on for a number of decades, in Stock's laboratory, into the chemistry of boron. It was carried out by the high-vacuum method, whereby the substances come in contact with only glass and mercury, under the complete exclusion of air and moisture. The experiments showed definitely that the ammonia compounds of the above hydrides must be regarded as salts of ammonia, and the hydrides themselves as acids.

Biographical memoir of Edward Charles Pickering: HARLOW SHAPLEY. (Read by title.)

Biographical memoir of Solon Irving Bailey: HARLOW SHAPLEY. (Read by title.)

Biographical memoir of Frank Wigglesworth Clarke: L. M. DENNIS. (Read by title.)

Biographical memoir of Arthur Williams Wright: E. S. DANA. (Read by title.)

The racial element in human metabolism: FRANCIS G. BENEDICT. A recent survey of the metabolism measurements of Mayas in Yucatan, the pure-blooded aboriginals of the Kokata Tribe in South Australia, Tamils and Malayalis in Madras, and a group of American-born, pure-blooded Chinese girls in Boston has demonstrated clearly that wide differences in the heat production of these various groups exist. They can not be explained on account of size, and only in part by sex differences, and with due regard to all possible differences in dietetic habits and climatic conditions, the assumption of a definite racial factor is justified.

Experiments on the mode of infection and means of prevention of poliomyelitis: SIMON FLEXNER. The mode of infection is an essential problem always arising during epidemics. Means of prevention to be adopted correspond, as far as practicable, to the manner of infection. The prevailing view is that the virus of poliomyelitis enters and leaves the body in the nasopharyngeal secretions. This view is based (1) on the presence of virus in these secretions from patients and healthy carriers; and (2) the ready infection of monkeys by way of the nasal membranes. Other modes of infection may exist. One which has often been considered is the carriage of the virus by lower animals living in close relation to man. Wild rats and mice caught in the severely affected districts of Brooklyn, New York, during the epidemic of 1931, were free of virus, and virus introduced into them experimentally survived only a few days. The gastro-intestinal tract in monkeys is traversed by the virus either not at all or with great difficulty. Monkeys resisting virus feedings respond to nasal inoculation. The recovery of virus from the contents of the intestine and the mesenteric lymph nodes in man has been effected very rarely. The conclusions drawn from these observations are that the virus is confined to the human host, and its main portal of entry into and escape from the body is by way of the nasal membrane, in which structure it selects the nerves of smell, passing along these to and from the brain and spinal cord. Specific prevention of poliomyelitis in monkeys can be accomplished by

the use of blood serum from recovered human beings and from monkeys given the disease experimentally. Certain adult persons, not known to have had poliomyelitis, also yield protective blood sera. This prevention, by passive transfer of immunity, is, however, effective for relatively brief periods of time. An enduring active immunity can be produced in monkeys through inoculations of virus. The methods hitherto employed have been uncertain in their action, for in exceptional instances, they have been followed by paralysis. Active immunization has, therefore, never been undertaken in man. New experiments to be described have had for their purpose a refinement of the methods of inducing active immunity in monkeys. They have dealt also with the problem of variation of the virus under conditions of natural and artificial propagation.

The time of ovulation in the menstrual cycle: CARL G. HARTMAN (introduced by G. L. Streeter). Gynecological data point to the middle of the menstrual cycle as the time when ovulation takes place in women but indicate that ovulation is possible at any time, even during the menstrual flow. The latter conclusion is reached upon testimony which does not bear scientific scrutiny. The crucial evidence, however, is the recovery of the egg, now accomplished six times in the human and about thirty times in the monkey. In all these cases ovulation occurred between days 9 and 18 (counting the beginning of the flow as day 1). Furthermore, sixty ovulation days were determined by rectal palpation of the monkeys' ovaries; these all occurred between days 9 and 17. The average for man and monkey is about day 14.

Models showing accumulation in the steady state: W. J. V. OSTERHOUT and W. M. STANLEY. It is often stated that living cells contravene physical laws, since in the process of accumulation penetrating substances attain a higher concentration inside than outside and thus appear to diffuse inward against a gradient. As attempts to explain this by the Donnan principle have failed in the case of *Valonia* the hypothesis of the steady state has been formulated to explain what occurs. In order to see whether this hypothesis is in harmony with physicochemical laws attempts have been made to imitate its chief features by means of a model. The model consists of a non-aqueous layer (representing the protoplasmic surface) placed between an alkaline aqueous phase (representing the external solution) and a more acid aqueous phase (representing the cell sap). The model reproduces most of the important features of the hypothesis. One important feature of the hypothesis is not seen in the model: this is the exchange of HCO_3 for Cl. Experiments on this point are in progress. Equations have been developed which enable us to predict the composition of the "artificial sap" in the steady state.

The concentrations of uric acid, sugar and phosphates in the glomerular urine of frogs, snakes and necturi: A. N. RICHARDS, ARTHUR M. WALKER and JAMES BORDLEY, III. Existing methods for the quantitative determination of substances have been adapted to the minute amounts of fluid which can be collected by micropipettes from the renal corpuscles of lower animals. The analyses indicate that the glomerular fluid has the composition of an ultrafiltrate of the blood plasma from which it is derived.

The implantation of the ovum in Macacus rhesus as compared with man: G. L. STREETER. Attention is called to three features that characterize the embedding of the human ovum. First of these is the superficial location of the site. The ovum does not penetrate deeply into the endometrium but just barely disappears under cover of the surface epithelium. On enlarging, it at once begins to bulge into the uterine cavity. The appearance of deep implantation results from transformation of the underlying endometrium. Secondly, the primary reaction of the endometrium is localized in the immediate vicinity of the ovum. And thirdly, there is marked reaction of the vascular system directly underlying the ovum resulting in large venous sinuses which spread around the ovum so that the latter, during this period, lies in an environment of relatively stagnant blood. The hemal environment is further added to by the destructive effect of the trophoblast upon the adjacent capillary walls, resulting in extravasations which promptly fill the trophoblastic lacunae, the precursors of the intervillous spaces. In the macaque similar principles prevail, though here the picture is somewhat altered, chiefly because of temporal difference in response of the endometrium and differentiation of ovum. The two opposing sites are definitely differentiated before the attachment of the ovum is completed. As in man, however, modifications in the capillary bed and subsequent communications between it and the trophoblastic lacunae establish the foundation of an intervillous circulation. This study is being made jointly with Dr. George B. Wislocki, of the Harvard Medical School, Boston.

Heredity of otosclerosis: CHARLES B. DAVENPORT. (Read by title.)

Critical geologic features of the Hoover Dam site: CHARLES P. BERKEY. Hoover Dam, because of its unprecedented height and the consequent exceptional physical changes that will be established by such a dam and reservoir, has required greater assurance than usual of satisfactory rock foundations and other geologic conditions. The great load calls for sound support and the increased water pressure tending to develop leakage and destructive attack emphasizes the importance of good petrographic quality. There must be provision also for the handling of flood waters in emergency through tunnels of enormous size, and this raises a question concerning stability under construction and danger to the workmen. Selection of the site in Black Canyon instead of Boulder Canyon was determined largely by its more favorable geologic conditions, including depth and cross-section of the gorge. The foundation rock is sound, essentially impervious, not badly jointed, is virtually free from constituents susceptible to ready attack by water, and comparatively resistant to destructive weathering. Such a fortunate combination of natural features

is seldom found in a region of so complex geologic history. The actual conditions thus far revealed at the present stage of construction tend to confirm the anticipated behavior. In addition to the special requirements at the dam site, there are equally critical features connected with the impounded water and its delivery. The heavy load of silt, tending by its accumulation in the reservoir to reduce its storage capacity; the salt deposits of the basin, tending to contaminate the water; the shifting sands of the dune belt crossed by the All-American canal, tending to obstruct its flow—all present problems that have had to be taken into account. The discussion is devoted to the relation between these geologic features and the plan and execution of the project.

1932 International Expedition to the West Indies. Marine geology: RICHARD M. FIELD (introduced by William Bowie). The purpose of the 1932 International Expedition to the West Indies was to determine whether a geological study of an oceanic area might yield results which would appreciably advance our knowledge of geological processes and subcrustal conditions. The decision to make this effort was strengthened by fundamental investigations by Dr. F. A. Vening-Meinesz in the East Indies and his 1928 expedition in the Gulf and Caribbean. The expedition, which completed its program at Miami on March 19, is also in a measure the result of a number of oceanographic investigations in the region of the Bahamas and neighboring waters, beginning with the cruise of the *Wild Duck*, directed by Alexander Agassiz, and ending with the series of Princeton expeditions initiated in 1927. The results of the 1929 expedition to the Bahamas are already in print or are in the course of publication, the latest paper being "The Microbiological Precipitation of Calcium Carbonate in the Tropical Sea." Following the 1929 expedition, it became obvious that the related problems presented by the region covered such a wide field of geological and biological research that an International Council was formed for the further investigation of these West Indian problems. Since it was felt that, at present, the fundamental question was the relation of the structure and stability of the islands to the origin, migration and alteration of the sediments which mantle their surfaces, the 1932 expedition was planned as a geophysical survey to provide further data as to the submarine topography and related subcrustal conditions affecting the local intensity of gravity. The expedition was made possible principally through the cooperation of Dr. Meinesz, the British Government, the United States Navy and the U. S. Coast and Geodetic Survey. Four thousand miles of sonic soundings have been made and sixty-six gravity stations determined (fifty-four at sea and twelve on the islands). The submarine profiles are already available, and a number of the gravity stations have been computed. Upon the completion of the isostatic reductions, a chart will be issued by the Hydrographic Office of the United States Navy which will show not only the results of the 1932 expedition but also all the geophysical data, including seismic epicenters, for the entire Gulf and Caribbean region and contiguous continental areas. It is expected that this chart will be available for distribution early this summer. The full report on the 1932 gravimetric survey (marine unit) will be published by the Hydrographic Office of the United States Navy.

The reports of the Princeton University expeditions to Patagonia: W. B. SCOTT.

Two types of sex determination in dioecious strains of maize: R. A. EMERSON. In some organisms the male is the heterogametic sex, producing two kinds of sperm, and the female is homogametic, producing only one kind of egg, with respect to sex determination. In other forms the male is homogametic and the female heterogametic. To the first group belong flies, man, certain fishes and some dioecious plants. To the second group belong moths, birds and certain fishes. Recently Jones has reported a dioecious strain of maize in which the male is the heterogametic sex. Using somewhat different material, I have synthesized two dioecious strains of maize, the male of one strain and the female of the other being the heterogametic sex. The male type used in producing these strains is what is known as barren stalk, *ba*, a simple Mendelian recessive having normal anther-producing tassels but no ear shoots. The female types employed are known as tassel-seed, producing seeds not only on the ear but also in the tassel to the exclusion of anthers. One of these, ts_1, is a simple Mendelian recessive and the other, Ts_2, is a simple dominant. These strains maintain an approximately 50–50 numerical relation between the sexes as do most dioecious species of plants and animals. Moreover, the known linkage relations of the heterozygous genetic factors of one strain make it readily possible to demonstrate typical sex linkage of certain common maize characters.

(To be concluded)

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